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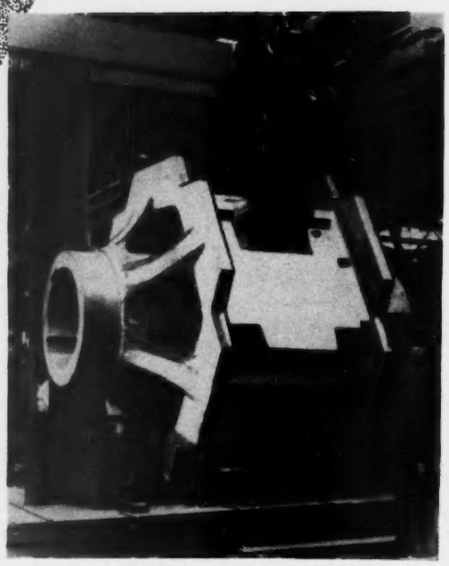
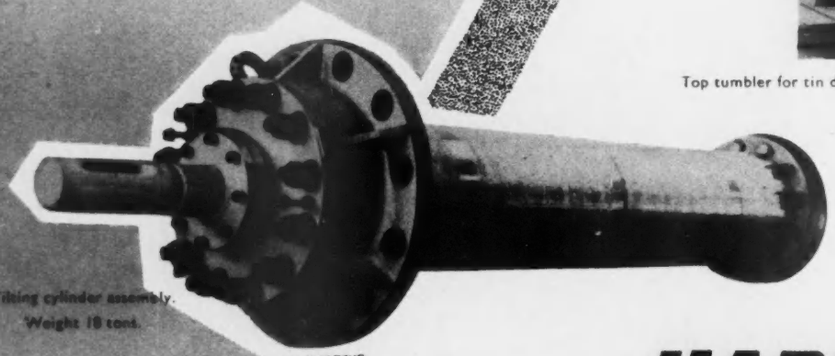


Top tumbler for tin dredging. Weight 17½ tons.



Tilting cylinder assembly. Weight 18 tons.

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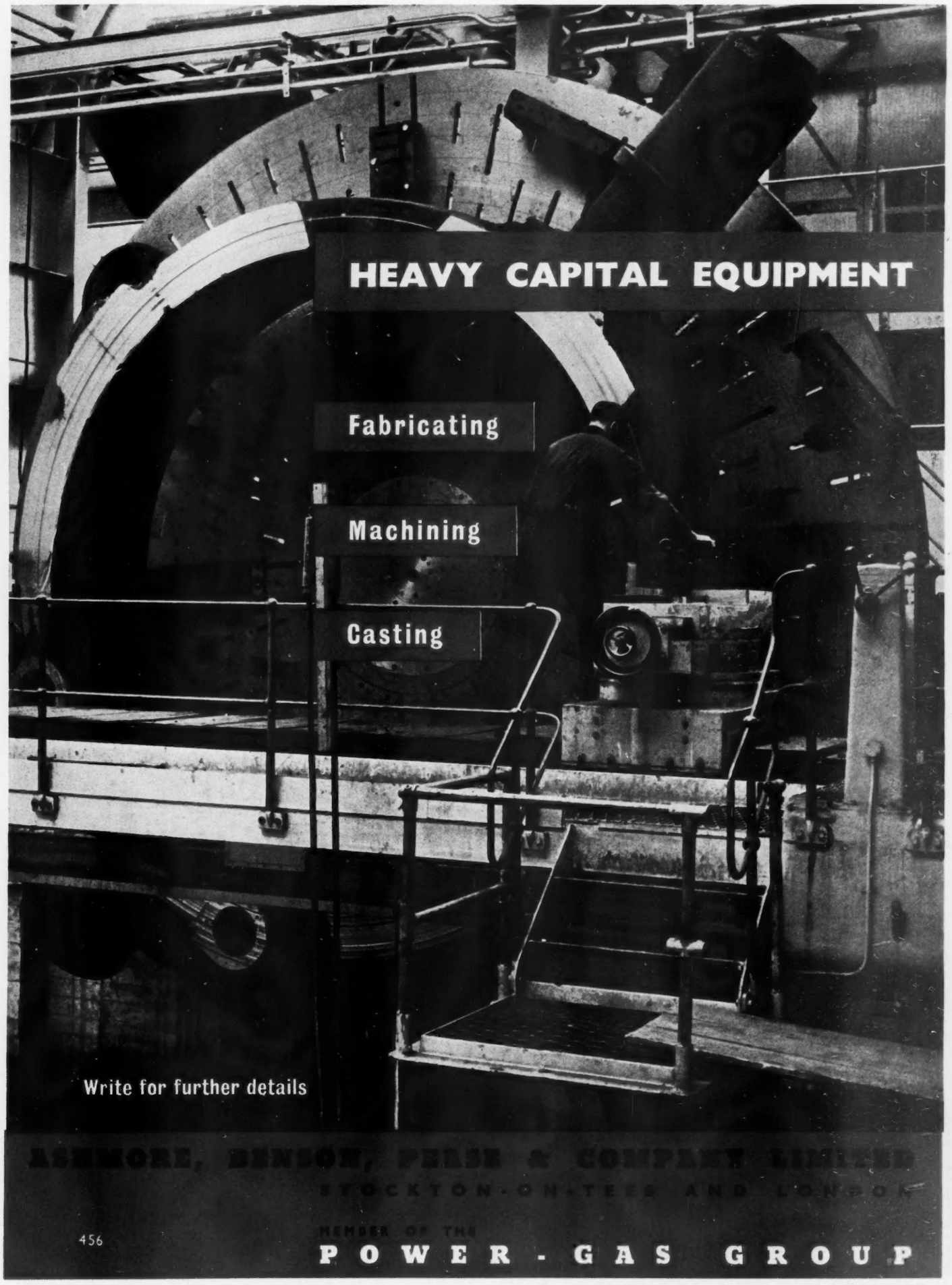
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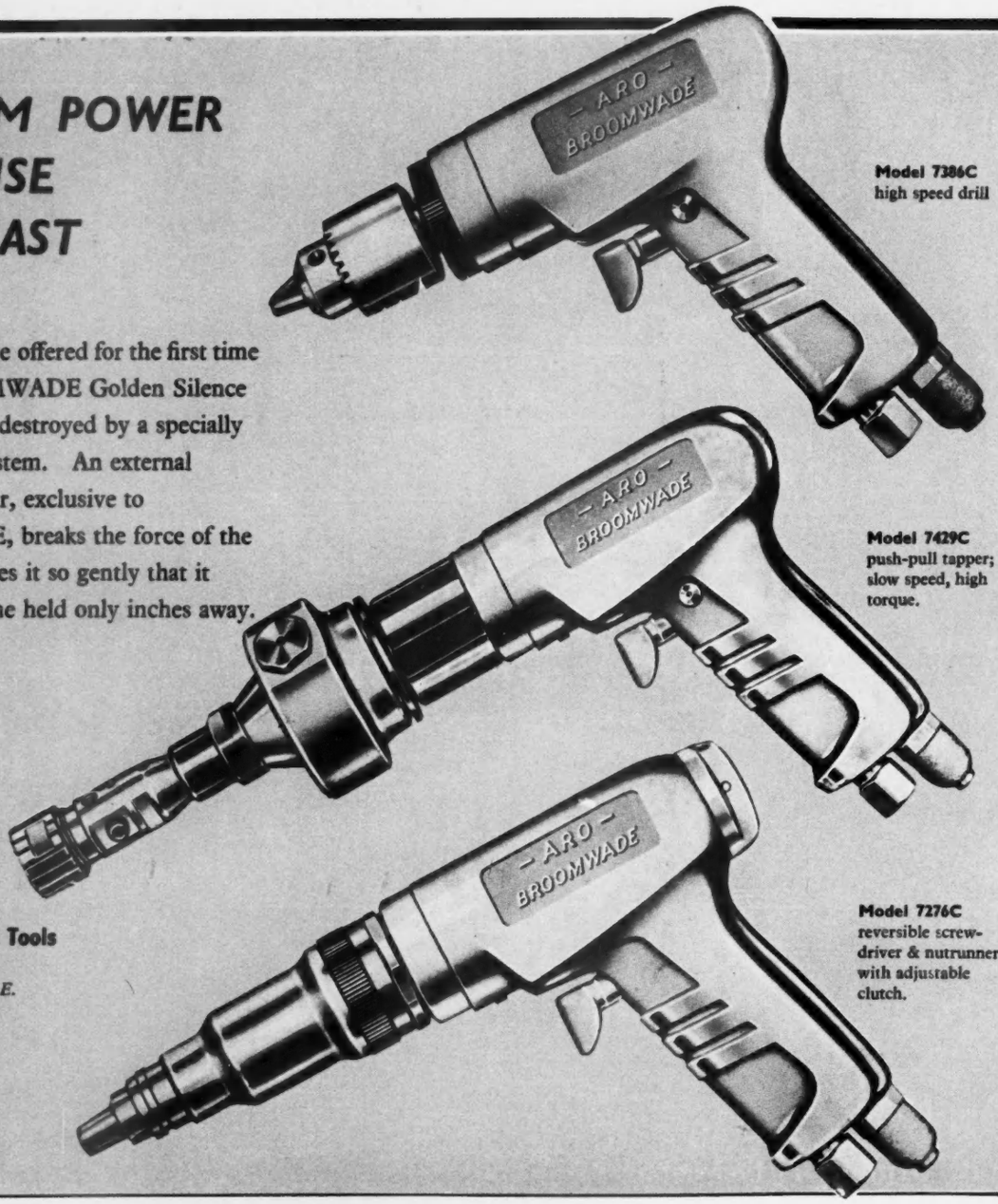


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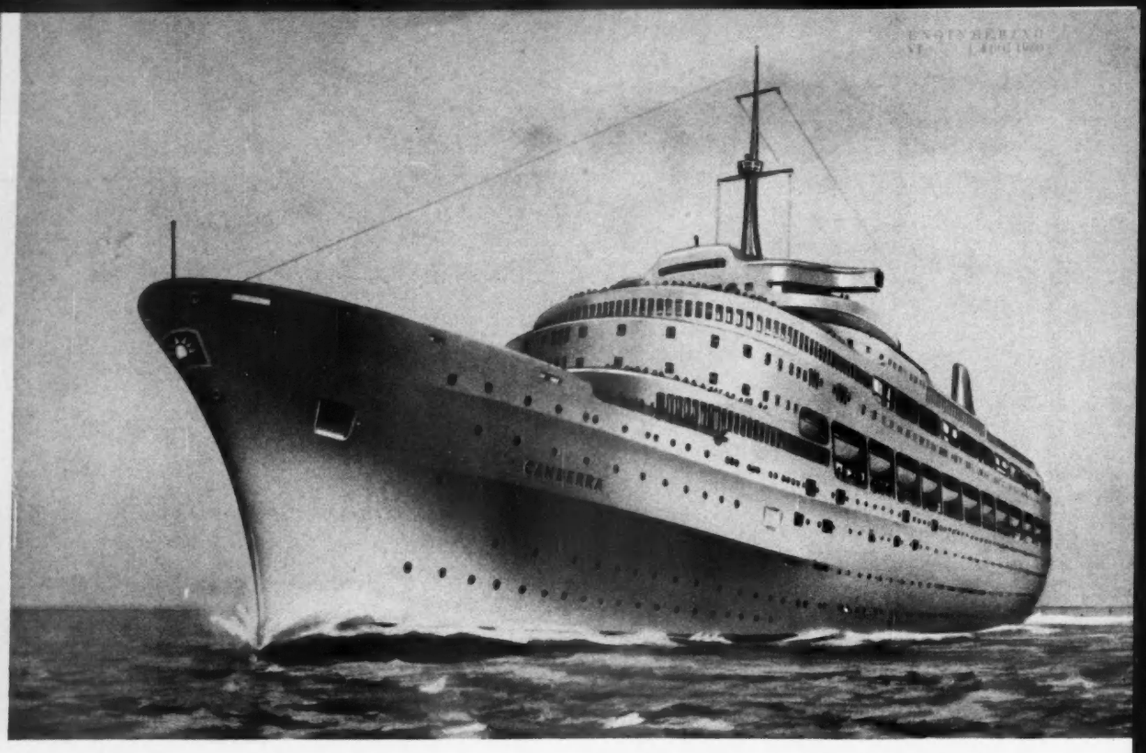

A cast steel stern frame for the CANBERRA, being lowered on the slip

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Clydeside is the subject of the first article in a series concerned with Engineering Growth in the Production Centres. The photograph of a plastic relief model map has been reproduced by permission of George Philip and Son Limited. (ENGINEERING *photograph.*)

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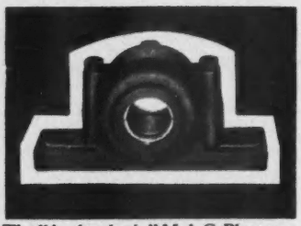

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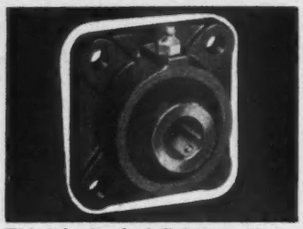

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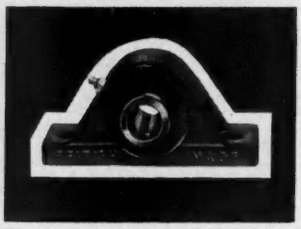

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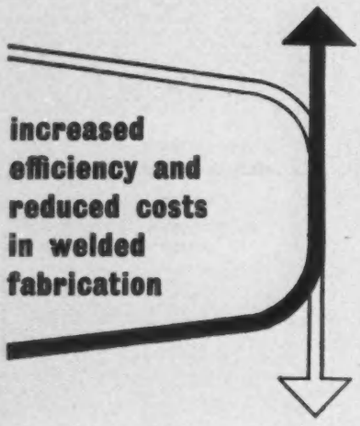


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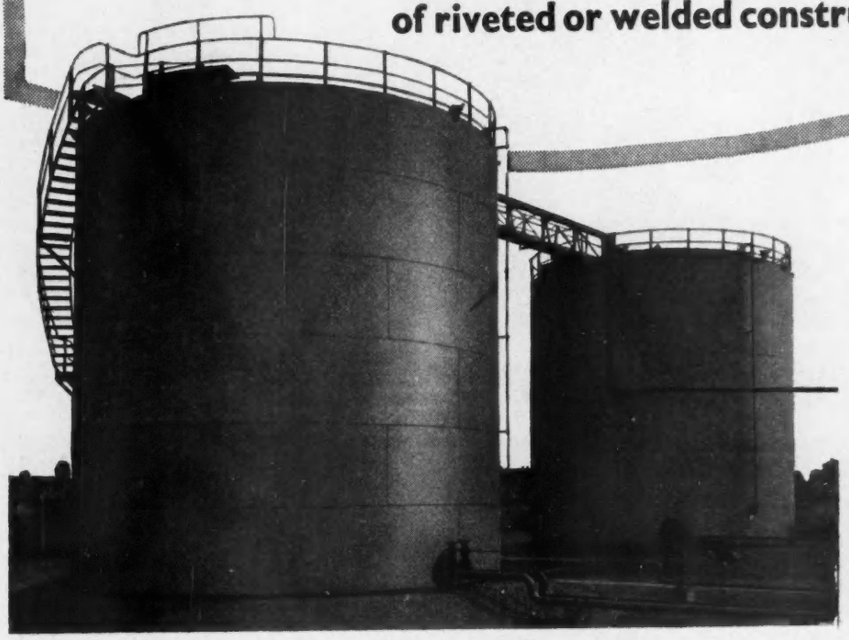

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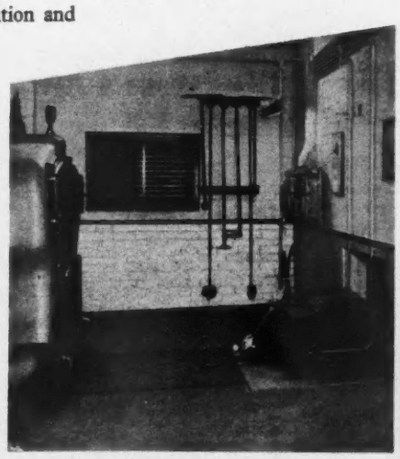

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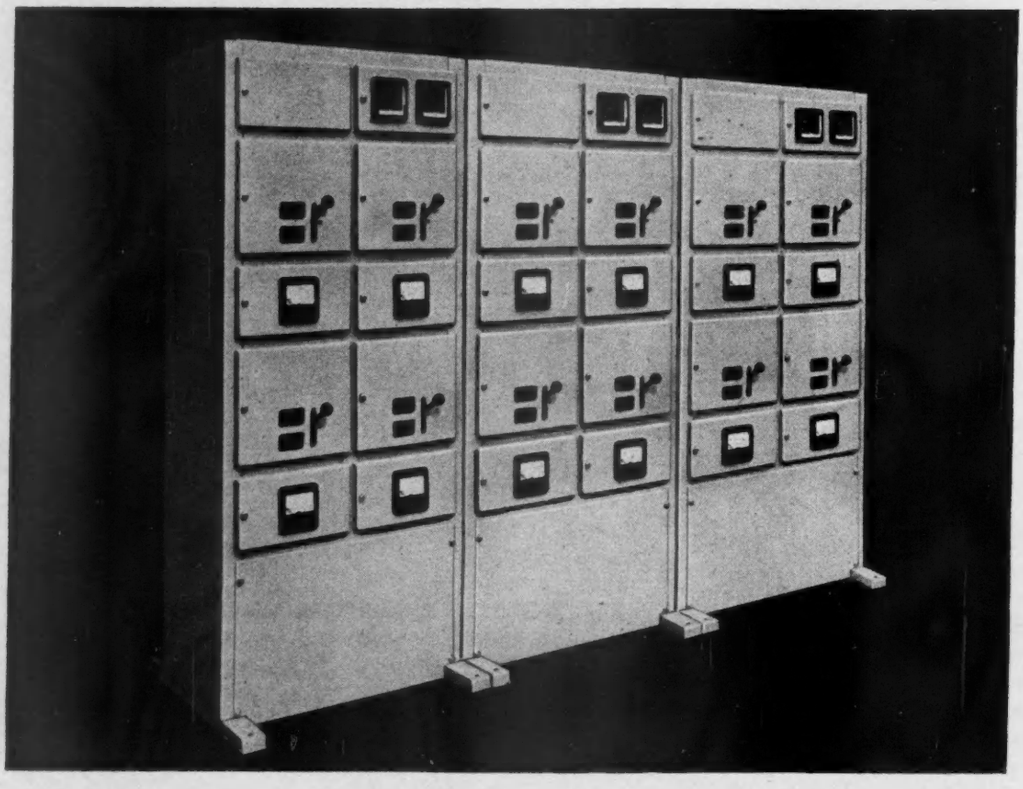

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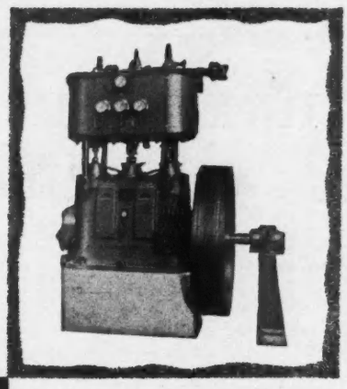

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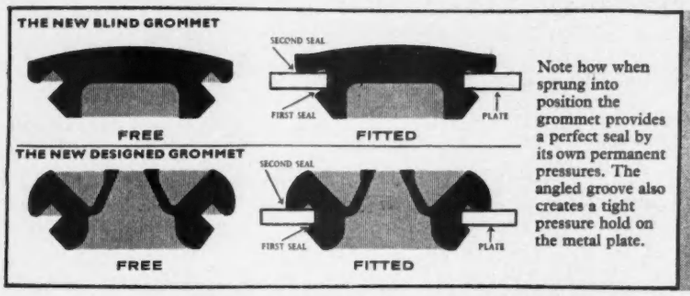
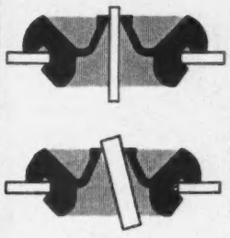
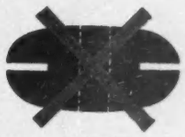



Note how when sprung into position the grommet provides a perfect seal by its own permanent pressures. The angled groove also creates a tight pressure hold on the metal plate.



A useful feature of this cable grommet is that by reason of the designed taper of the cable entry and the flexibility of the web, a considerable angle of cable entry and a variety of cable size, are possible. This avoids necessity for special grommets with angled bores.



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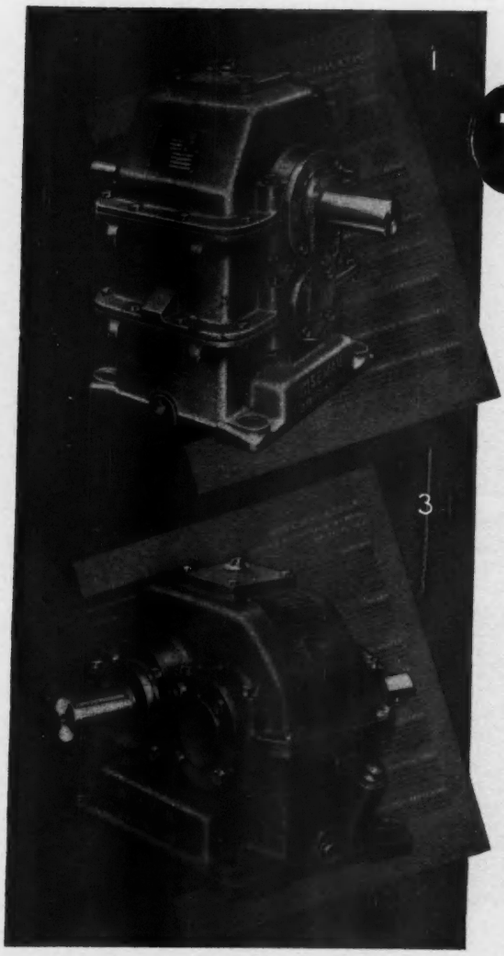


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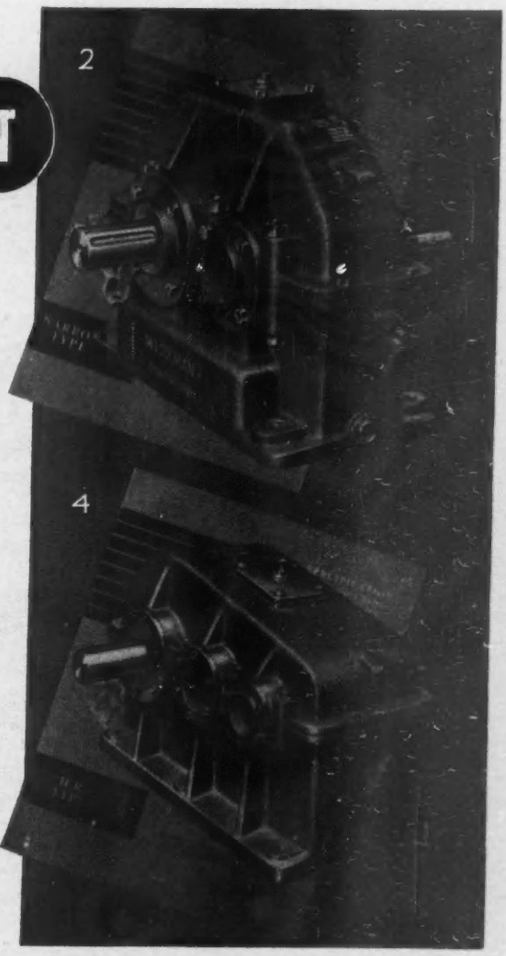

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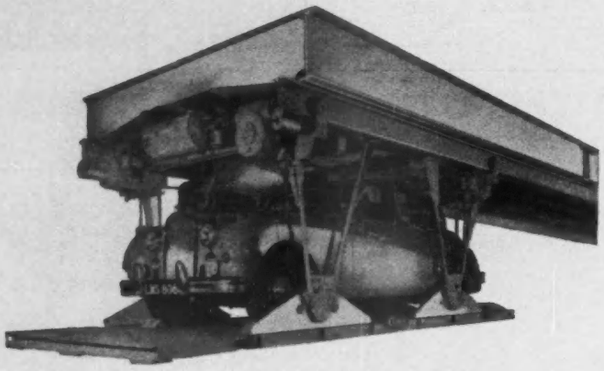

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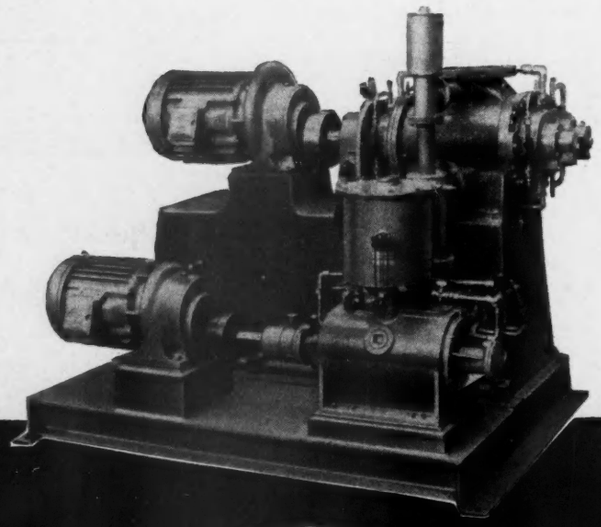

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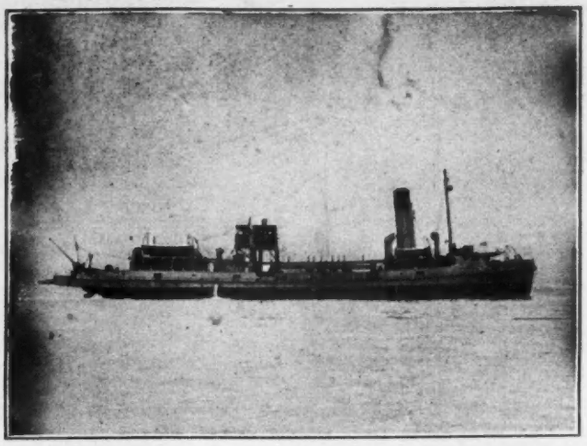

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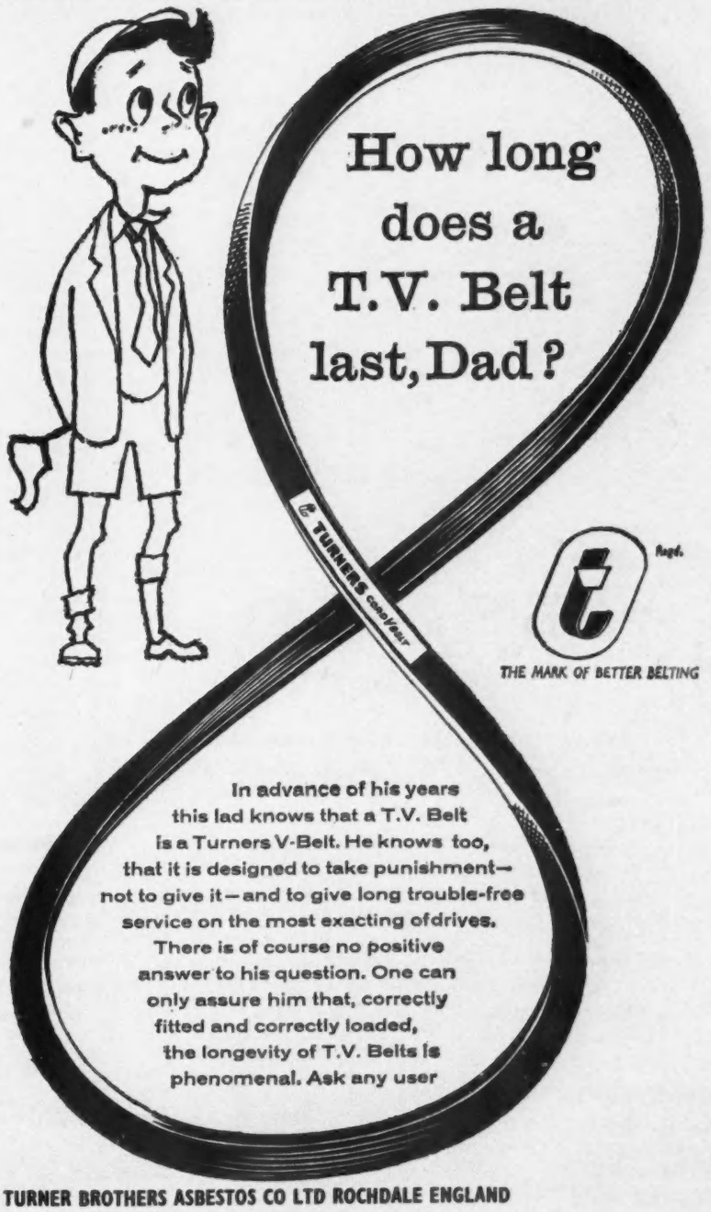
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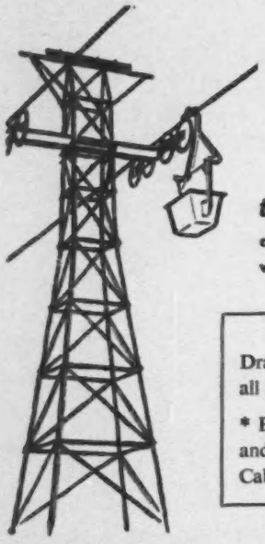

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The 1960 Fuel Efficiency and Power for Industry Exhibition will be the largest display of fuel and power-saving equipment ever to be shown. Nearly 150 exhibitors will demonstrate the widest possible range of fuel efficiency and power-saving equipment, including the following:—

- Every conceivable type of Steam Raising Plant
- Economisers
- Automatic Control Gear
- Steam Distribution Accessories
- Evaporators
- Instrumentation
- Liquid Fuel and Coal Firing Equipment
- Coal and Ash Handling
- Oil Storage
- Gas and Electric Furnaces
- Refractory and Insulating Materials
- Gas Producers
- High and Medium Pressure Hot Water Boilers
- Industrial Fuels
- Nuclear Power and many other types of equipment associated with Efficiency in the generation and utilisation of Heat and Power.

This is, therefore, an opportunity for you to see all the latest developments and equipment associated with Fuel Efficiency and Power for Industry.
An important series of Technical Conferences will take place during the Exhibition in the Conference Hall. A programme of Technical Sessions will be available at a later date.

*For full details please write to the Organisation :*

**PROVINCIAL EXHIBITIONS LIMITED**

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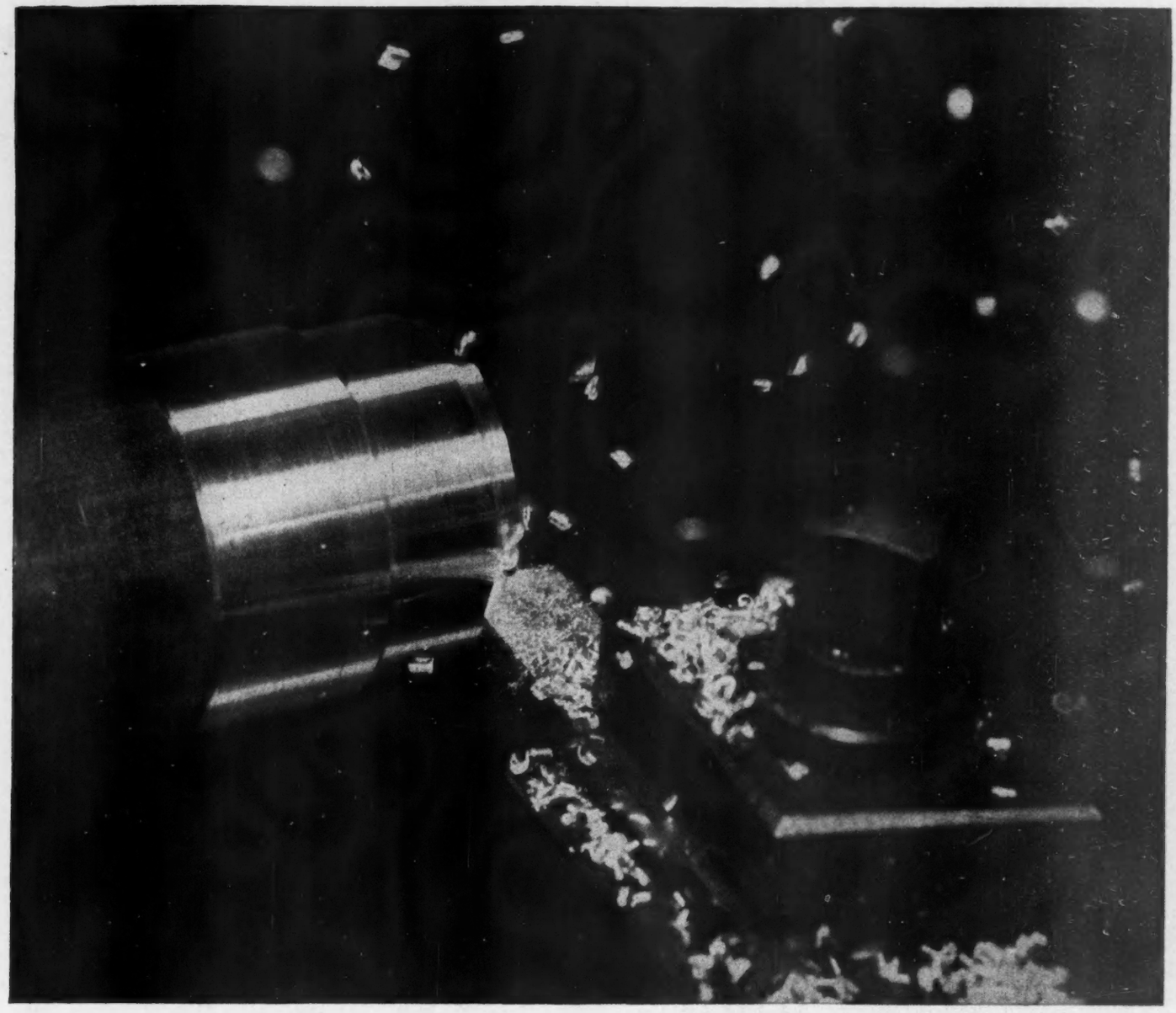
*(In association with F. W. BRIDGES & SONS LTD.)*



*Headstock speed 610 r.p.m., Traverse .005 in. per rev., Depth of cut .05 in. using tool with no rake. Photo taken with high speed electronic flash at 1/5000 sec. and f.16.*

# DURALUMIN 'C' machines like this

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This photograph shows the results obtained from our aluminium alloy, Duralumin 'C'. This new addition to our range of light alloys has been developed specially for its outstanding machining properties and is meeting with remarkable success.

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- No swarf build-up. It comes away in tiny chips.
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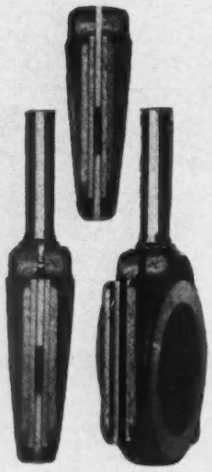
TOA JBG116C

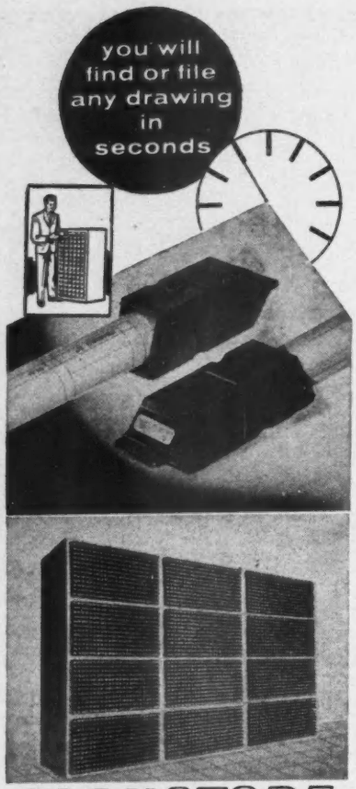
V23

introducing the
flexible wedge disc
by **CRANE**



Crane once again underline their pre-eminence in the valve field with the development of the Flexible Wedge Disc for Gate Valves on steam service where high pressures and high temperatures are being used. The Flexible Wedge Disc is especially suited to most service conditions up to about 1100°F and can be supplied for Nos. 47, 33 and 76 Cast Steel Wedge Gate Valves (British or American Standard end connections). The outstanding features are: **(a)** The flexibility of the disc eliminates the possibility of its sticking in the closed position. **(b)** It takes less torque to unseat from the closed position, and likewise less torque to seat. This feature is especially useful on motor operated valves. **(c)** It remains tight on both sides—at the inlet seat as well as the outlet seat—over a wide range of pressures. The body of the valve remains pressureless when closed. Crane manufacture steel valves for many purposes and services involving steam pressures up to 600 pounds and temperatures up to 1100°F. Individual testing during and after manufacture ensures peak performance and reliability always. They are made with screwed, butt-welding or flanged ends to British Standards F, H, J, K and R, and also to American Standards.

The Crane Flexible Wedge Disc is more fully described in Leaflet No. 452, which can be sent on application to Dept. 18, Crane Ltd., 15-16 Red Lion Court, Fleet Street, London, E.C.4. Works: Ipswich. Branches: Birmingham, Brentford, Bristol, Glasgow, Leeds, London, Manchester.

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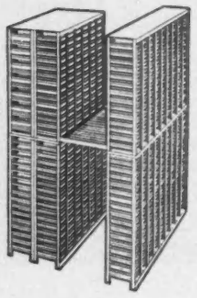

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# CENTRAL ELECTRICITY GENERATING BOARD

## TARIFF FOR BULK SUPPLIES TO AREA BOARDS

fixed by the Central Electricity Generating Board (the Generating Board) pursuant to section 37 (1) of the Electricity Act, 1947, for the year ending 31st March, 1961.

### NORMAL KILOWATT CHARGE

£7.2s.0d. (seven pounds two shillings) for each kilowatt of the number ascertained by multiplying by 24,000,000

the maximum number of kilowatts determined by deducting from the **half-hour kilowatt demand** supplied to the Area Board the **half-hour kilowatt demand** of the **special consumers** in the same half-hour and adding the sum of the **nominated firm kilowatts** and the **excess kilowatts** (if any) of the **special consumers**

and dividing the product by

the sum of the said maximum number of kilowatts for each Area Board and the chargeable kilowatts in the year of other direct consumers of the Generating Board.

### RESTRICTABLE KILOWATT CHARGE

The above Normal Kilowatt Charge less £3.19s.0d. (three pounds nineteen shillings) for each kilowatt of the sum of each maximum **half-hour kilowatt demand** of **special consumers** less the sum of their **nominated firm kilowatts** and less the sum of their **excess kilowatts** (if any).

For the above purposes—

(i) **"the half-hour kilowatt demand"** means twice the number of kilowatt-hours supplied in any half-hour between 7.0 a.m. and 7.0 p.m. on any Monday, Tuesday, Wednesday, Thursday or Friday, or between 7.0 a.m. and 12.0 noon on any Saturday in the year.

(ii) **"special consumer"** means a consumer of the Area Board who has agreed that (without prejudice to any statutory right which the Area Board may have to discontinue the supply of energy) his kilowatt demand can be restricted by the Generating Board for up to 2 hours on any occasion and up to an aggregate of 50 hours in the year provided that

(a) The supply is afforded to the consumer's premises directly from a generating station or substation of the Generating Board through circuits not used for supplies to other consumers.

(b) The difference between the consumer's maximum **half-hour kilowatt demand** and his **nominated firm kilowatts** shall be not less than 25,000 kilowatts.

(c) Suitable provisions have been made in respect of the costs of connection and the technical arrangements for operation, control, and metering, which may vary with local circumstances, and

(d) Prior agreement has been made between the consumer, the Area Board and the Generating Board in each case.

(iii) **"Nominated firm kilowatts"** means the **half-hour kilowatt demand** which in accordance with the above arrangements the **special consumer** is entitled to make during a period of restriction.

(iv) **"Excess kilowatts"** means the amount by which the **nominated firm kilowatts** is exceeded by twelve times the largest number of kilowatt-hours supplied to the **special consumer** in any five minutes (excepting the first five minutes) during any period commencing when the Generating Board indicate (by a signal or otherwise) that they require his demand to be restricted in accordance with the above arrangements, and ending when the Generating Board indicate that normal supply may be resumed.

### RUNNING CHARGE

0.41d. (decimal four one of a penny) for each kilowatt-hour supplied during the year, this charge to be increased or reduced by 0.00055d. (decimal nought nought nought five five of a penny) for each penny (a halfpenny or any greater part of a penny being treated as a penny) by which the fuel cost per ton in the year shall be above or below 60s. (sixty shillings).

For this purpose—

(i) **"Fuel cost per ton"** in any period shall be either

(a) the quotient produced by dividing the aggregate of the product of the **Area fuel cost per ton** in the period and the **number of kilowatt-hours supplied from generation in the Area** in the period and the product of the **residual cost per ton** in the period and **the number of kilowatt-hours imported into the Area** if any in the period by **the number of kilowatt-hours supplied in the Area** in the period; or

(b) **the Area fuel cost per ton ;**
whichever is the less.

(ii) **"The Area"** means the Area of the Area Board taking the supply.

(iii) **"The Area fuel cost per ton"** in any period shall be determined as follows: the total **cost of fuel consumed** in the period at all the Generating Board's stations in **the Area** shall be divided by the total number of tons of **fuel** so consumed and the cost per ton so obtained shall be multiplied by 11,000 and divided by the average gross thermal value of **fuel** so consumed expressed in British thermal units per pound.

(iv) **"Fuel"** shall mean coal, coke and oil fuels but shall not include atomic fuels.

(v) **"The cost of fuel consumed"** shall mean the sums expended for **fuel** consumed plus the cost of any transport, handling preparation or treatment incurred in connection with the delivery of the **fuel** to boiler hoppers or furnaces and in connection with the disposal of the products or residues of combustion, together with the proper proportion of salaries and wages and any contributions for pensions, superannuation and insurance of officers and servants attributable thereto and the amount of any rebate allowed by the suppliers from the price of heavy fuel oil delivered at the Generating Board's stations, such rebate being attributable only to a specific quantity of heavy fuel oil so delivered, less any sums received from the sale of any products or residues of combustion.

(vi) **"The number of kilowatt-hours supplied from generation in the Area"** in any period means the number of kilowatt-hours (being kilowatt-hours generated by the combustion of **fuel**) sent out from all the stations of the Generating Board in **the Area** in the period or **the number of kilowatt-hours supplied in the Area** in the period whichever is the less.

(vii) **"The number of kilowatt-hours supplied in the Area"** in any period shall mean the number of kilowatt-hours supplied in the period by the Generating Board to the relevant Area Board and to other consumers in **the Area.**

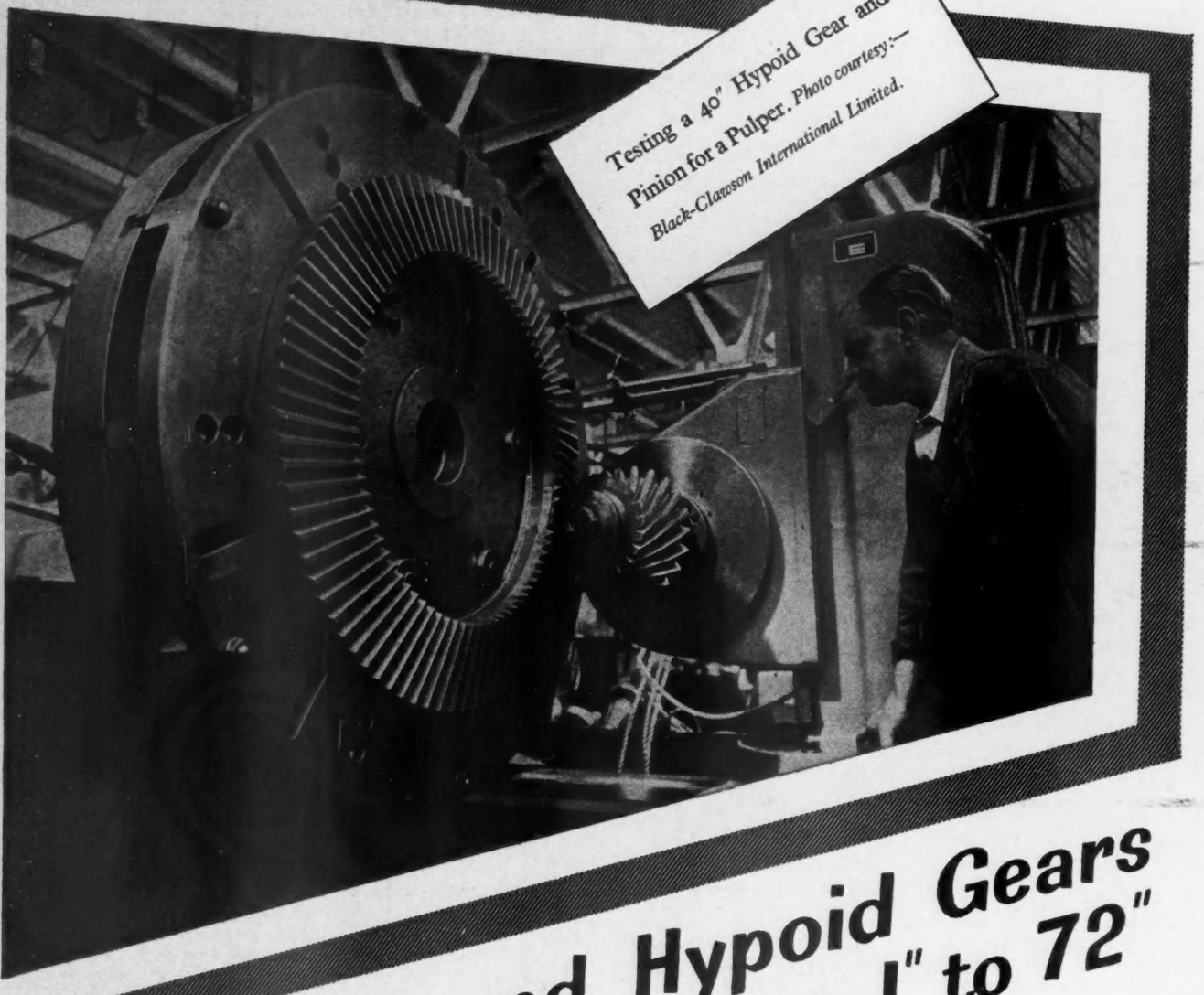
(viii) **"The number of kilowatt-hours imported into the Area"** means the amount if any by which **the number of kilowatt-hours supplied in the Area** exceeds **the number of kilowatt-hours supplied from generation in the Area.**

(ix) **"The residual cost per ton"** in any period shall mean the aggregate of—

(A) the quotient produced by dividing the amount by which **the national fuel cost per ton** in the period multiplied by the aggregate of **the number of kilowatt-hours supplied in the Area** of each Area Board in the period exceeds the aggregate of the respective products in the case of each Area Board of (a) **the Area fuel cost per ton** in the period and (b) **the number of kilowatt-hours supplied from generation in the Area** in the period, by the aggregate of the **number of kilowatt-hours imported into the Area** of each Area Board in the period; and

(B) the sum of 6s. (six shillings).

(x) **"The national fuel cost per ton"** in any period shall be determined as follows: the total **cost of fuel consumed** in the period at all the Generating Board's stations shall be divided by the total number of tons of **fuel** so consumed and the cost per ton so obtained shall be multiplied by 11,000 and divided by the average gross thermal value of the **fuel** so consumed expressed in British thermal units per pound.



Testing a 40" Hypoid Gear and Pinion for a Pulper. *Photo courtesy:— Black-Clawson International Limited.*

# Spiral Bevel and Hypoid Gears from 1" to 72"

Spiral bevel and hypoid gears offer many advantages for right angle drives where high efficiency and smooth, silent running are required.

E.N.V. specialise in the design and manufacture of straight and curved tooth bevel gears. They offer collaboration with engineers from the project stage on the design of gears and mountings. They have unique facilities for the large-scale manufacture of transmissions including final drives, differentials and axles for vehicles and agricultural equipment, precision gears for aircraft and gears for industrial applications.

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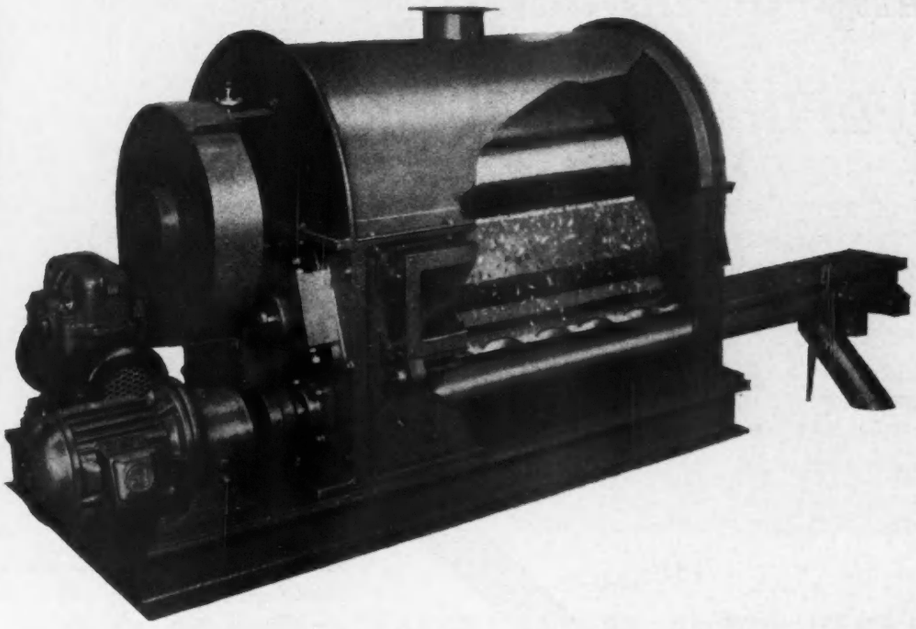
AP 56

# SIMON

PATENT

## COOLING & FLAKING MACHINE



In constant production in a large number of sizes ranging from 8in. dia. by 8in. long to 42in. dia. by 108in. long. Rolls are constructed of cast iron, chromed cast iron, nickel iron, stainless steel, phosphor bronze, etc.

Machines have been supplied to leading chemical manufacturers at home and abroad for flaking such materials as naphthalene, phthalic anhydride, carbamite, stearines, waxes, etc., etc.

Test machines are available at these Works, and experiments are carried out on customers' materials without charge or engagement.

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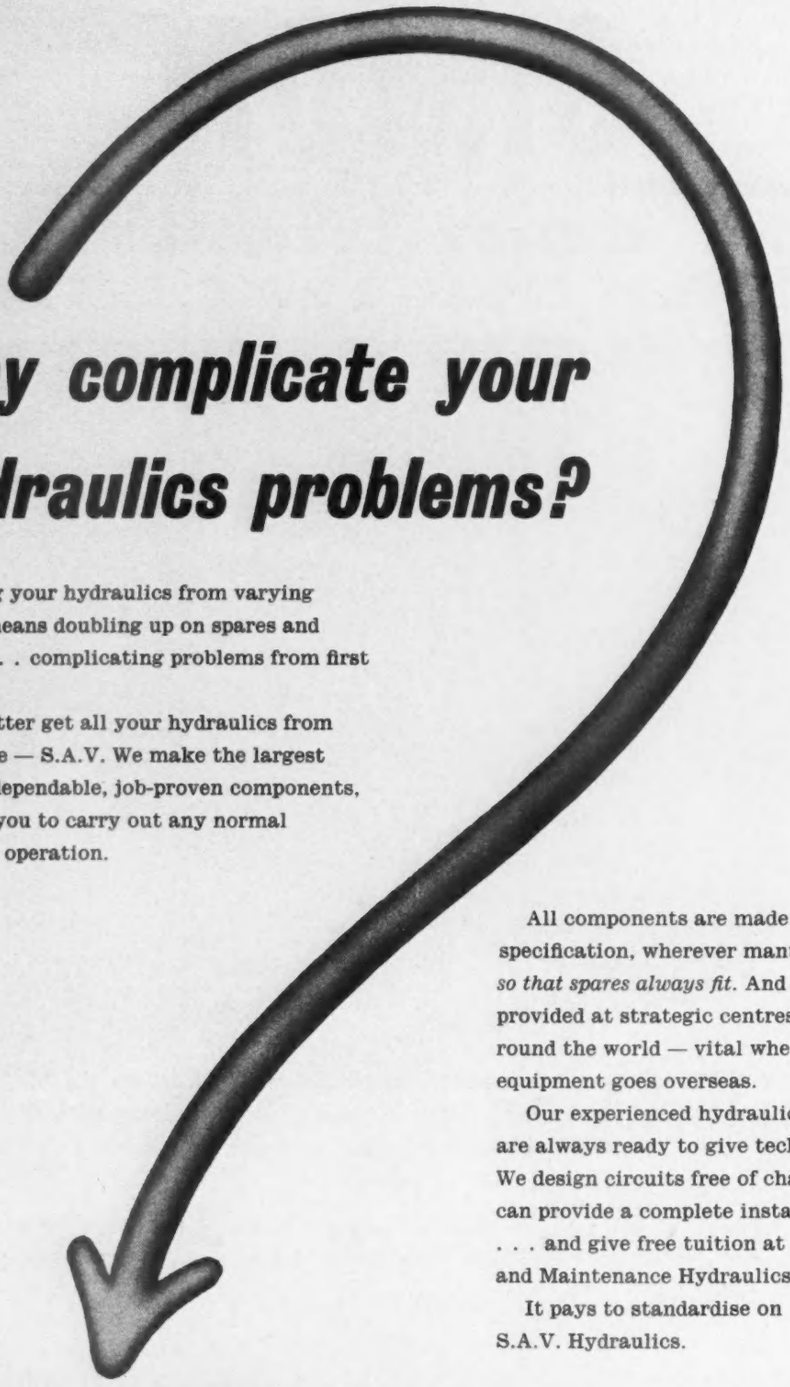

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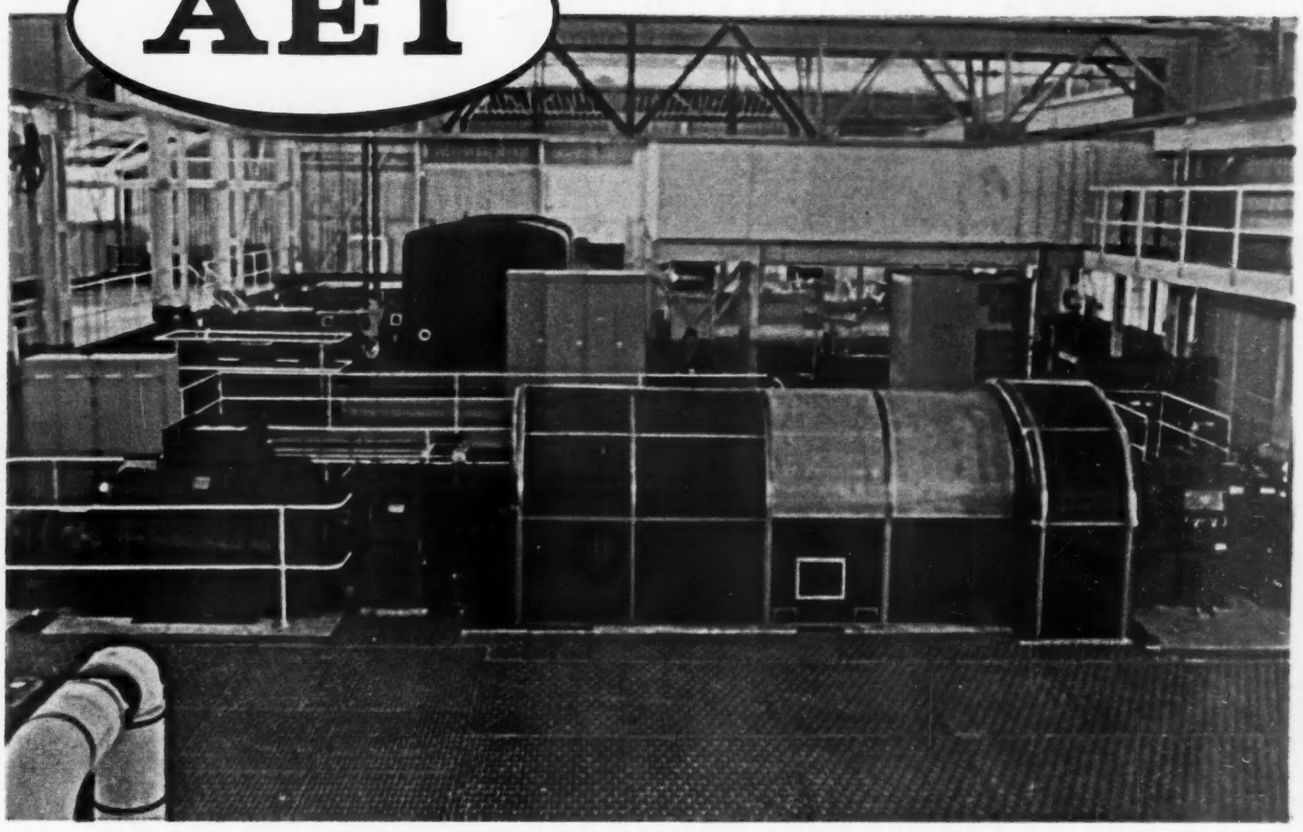

# 1750 kW GAS TURBINE-GENERATOR

## Over 19,000 Hours Base Load Service In VENEZUELA

The 1750 kW gas turbine-generator, on base load service in a Shell oilfield near Maracaibo, Venezuela, has completed more than 19,000 hours running on natural gas from the oilfield.

It is a typical example of the Series L axial-flow industrial gas turbines manufactured by A.E.I Turbine-generator Division for electrical generation and mechanical-drive applications, with ratings between 1750 kW and 22,000 kW.

Units of 4000 kW and 4500 kW are being supplied to oilfields in Iran and British North Borneo, and a similar machine is being built under licence, in Italy.

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TURBINE-GENERATOR DIVISION

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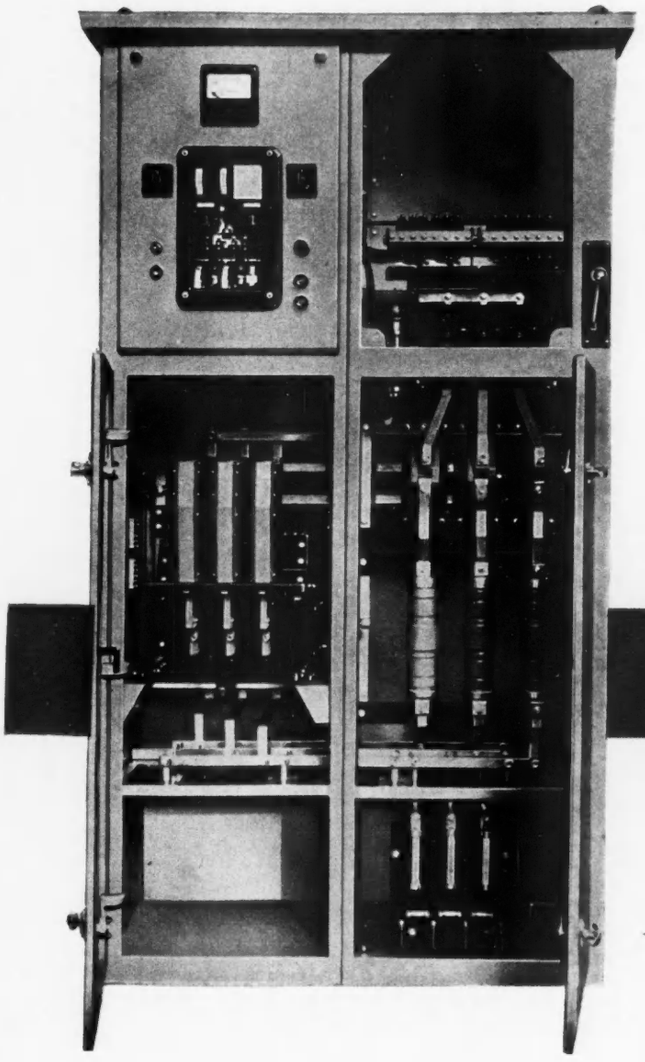
# THE BELMOS 3·3kV AIR-BREAK CONTACTOR STARTER

Rigorously tested in the Company's own research laboratory, the type K contactor starter is the latest product of the Belmos development team and continues the well-established Belmos tradition of good design and reliability. Suitable for the direct-on-line starting of 3·3 kV motors up to 600 h.p., it can be housed in a free-standing pillar or grouped with similar units to form a switchboard.



- ★ Air-break contactor rated at 150 amperes. Breaking capacity of 1,300 amperes at 3·3 kV, 0·25 power factor.
- ★ D.C. operating magnet supplied from 3,300/110 volt transformer within the pillar.
- ★ Reversing or Earthing isolator, mechanically and electrically interlocked, with 12 auxiliary switches, a.c. or d.c.
- ★ Busbars designed to withstand 150 MVA for three seconds.
- ★ Optional earth leakage protection.
- ★ Comprehensive control arrangements, local and remote, with sequence interlocking and automatic sequence starting.
- ★ Provision for auxiliary services, such as brake protection local lighting, etc.

✶

*the type K starter is fully described and illustrated in leaflet J240 which is available on request.*

**Belmos**

**the Belmos company limited**

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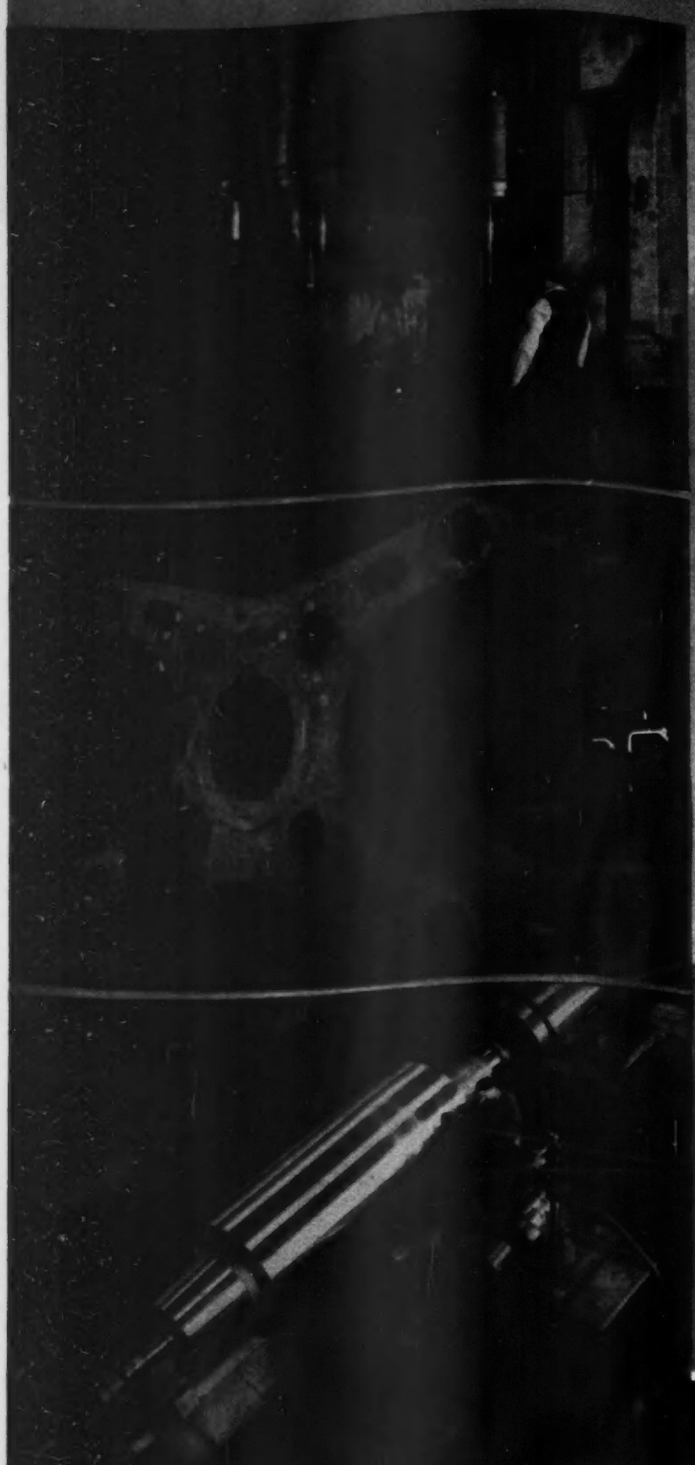
# Over 100 years service to Britain's Engineering Progress



A Company's reputation is built up on the quality of the work which it produces. During the past 100 years the name of The Darlington Forge Limited has grown to be associated throughout the world with the production of Forgings and Castings of the highest order for the Marine and General Engineering Industries.

In the past, the Company's moulding pits and forging presses have produced structural and engine components for many of the world's greatest ships. Today they are making their own invaluable contribution to the expansion of Britain's heavy industrial capacity.

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The Darlington Forge Ltd

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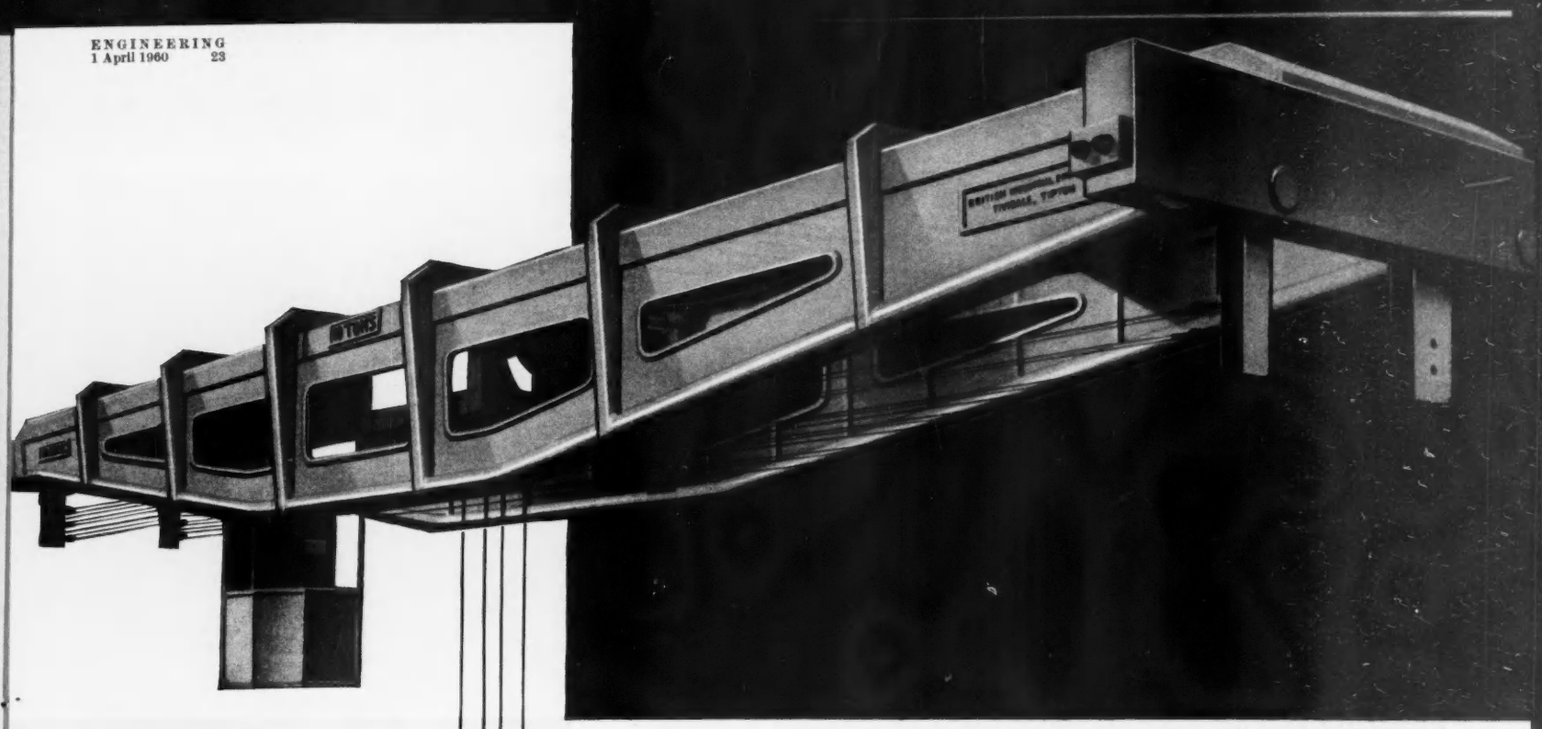

Manufactured under licence from Ferrand & Frantz Ing. Villeurbanne. British Patent No. 705,148.

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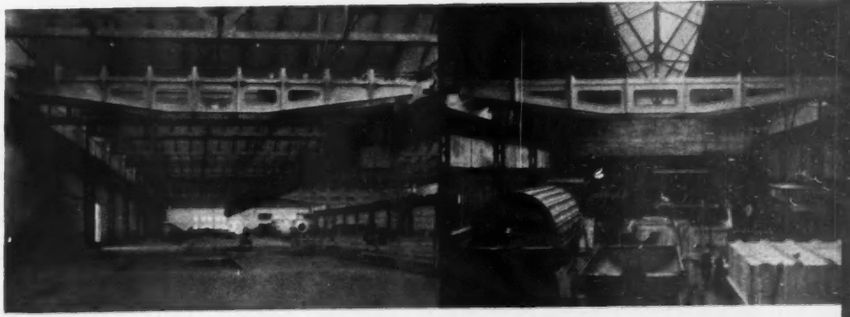
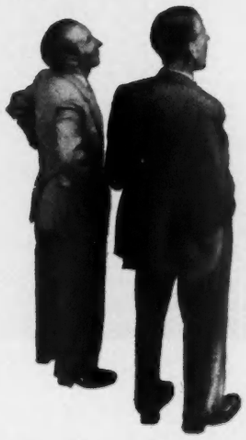
*Full information on request.*

**THE BRITISH**

## "RÉEL"

**OVERHEAD CRANE**





## BRITISH INDUSTRIAL

**ENGINEERING COMPANY (STAFFS) LIMITED**

CORONATION WORKS · HAINGE ROAD · TIVIDALE · TIPTON · STAFFS · Tel: TIPTON 1222/3/4

# Rotary Water Strainers

Size 'N' for 3,500,000 G.P.H.

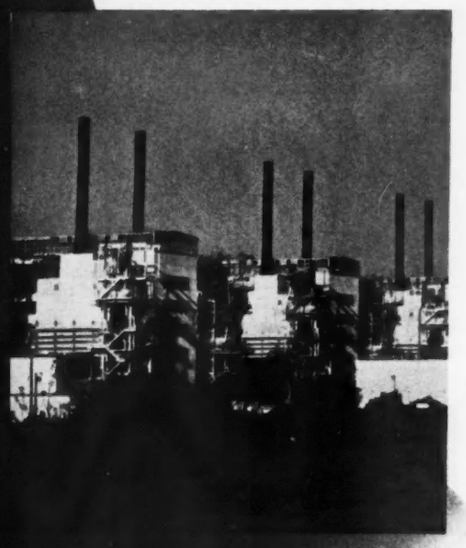
The Hick Hargreaves self-cleaning enclosed Rotary Water Strainer is proving, in service throughout the world, to be the most effective means of removing floating debris. The strainer comprises a motor driven wheel, slowly rotating inside a casing, the straining medium which is between the spokes being so designed to prevent the interlacing of fibrous matter. The head loss through the strainer does not exceed 2 feet. The debris is removed from the strainer by a series of jets, and discharged from an internal chamber which is effectively sealed off from the main water space. All water connections are placed in the lower half of the casing and large access doors are provided for routine examination. Installation is extremely simple, no extensive foundation work being necessary. The strainer can be located on either the suction or discharge side of the circulating water pumps.

The Hick Hargreaves Rotary Strainer is available in a range of capacities up to 5,000,000 g.p.h. with mesh of $\frac{1}{16}$" to $\frac{1}{4}$" diameter inscribed circle.

## Hick Hargreaves

AND COMPANY LTD · BOLTON

# Colvilles Special Steels



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**ABRAZO** Abrasion Resisting Steel.
**COLMO** Creep Resisting Steel.
**COLCLAD** Stainless, nickel and monel clad Steels.
**CORTEN** High strength Corrosion Resisting Steel.
**COLTUF** Notch Tough Steels.
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# Rotary Water Strainers

*Size 'N' for 3,500,000 G.P.H.*

The Hick Hargreaves self-cleaning enclosed Rotary Water Strainer is proving, in service throughout the world, to be the most effective means of removing floating debris. The strainer comprises a motor driven wheel, slowly rotating inside a casing, the straining medium which is between the spokes being so designed to prevent the interlacing of fibrous matter. The head loss through the strainer does not exceed 2 feet. The debris is removed from the strainer by a series of jets, and discharged from an internal chamber which is effectively sealed off from the main water space. All water connections are placed in the lower half of the casing and large access doors are provided for routine examination. Installation is extremely simple, no extensive foundation work being necessary. The strainer can be located on either the suction or discharge side of the circulating water pumps.

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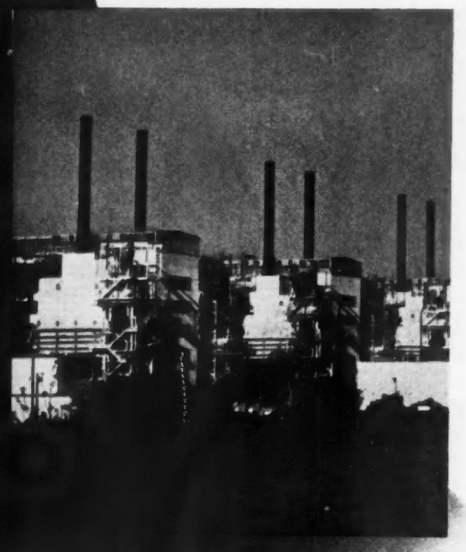
# Hick Hargreaves

AND COMPANY LTD · BOLTON

# Colvilles Special Steels



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**COLMO** Creep Resisting Steel.

**COLCLAD** Stainless, nickel and monel clad Steels.

**CORTEN** High strength Corrosion Resisting Steel.

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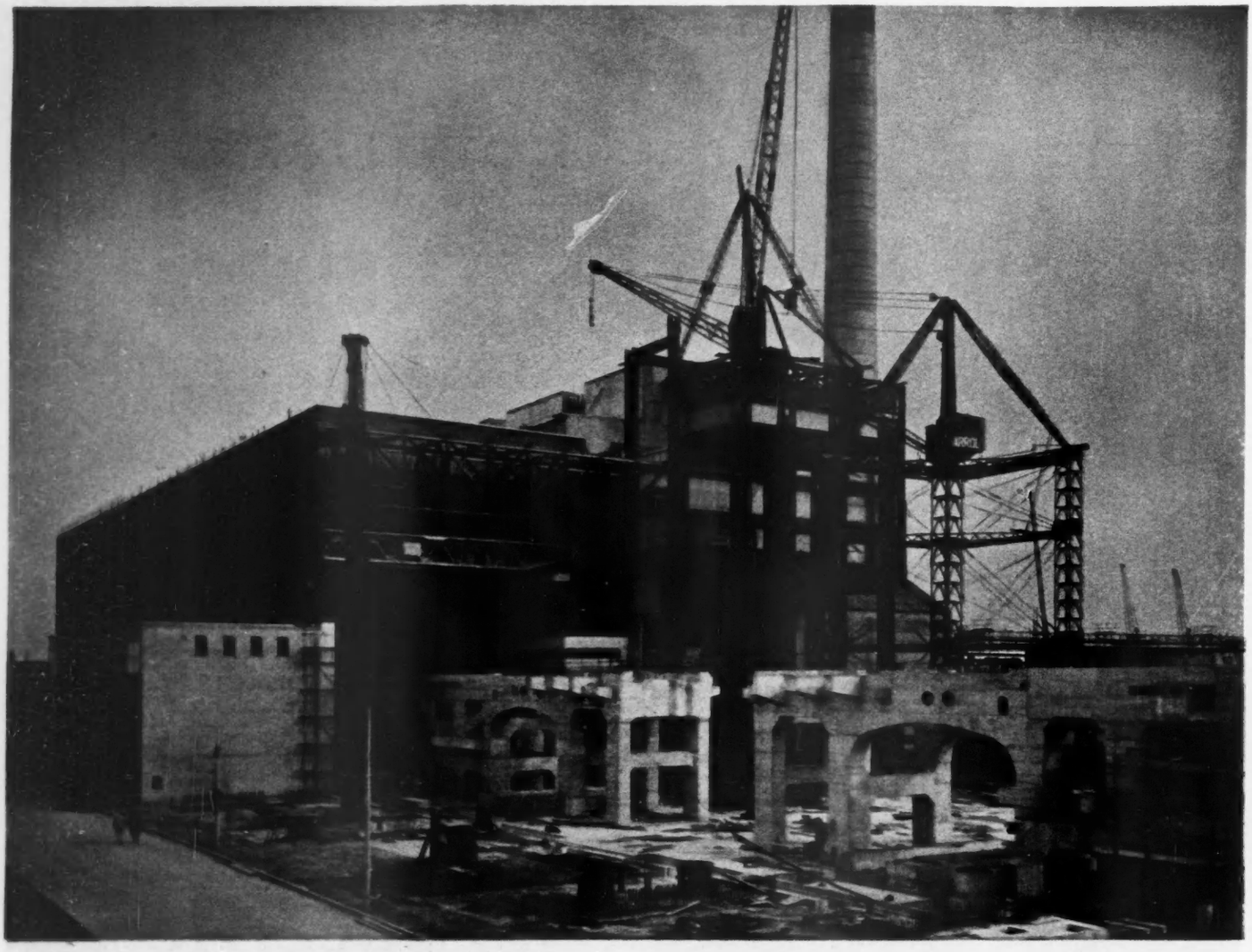

# *Steelwork for Power Stations*

Throughout the country steel-framed Power Station structures indicate the close association of ARROL of GLASGOW with Britain's electrical power development. Battersea and others in the London area, Castle Donington in Leicestershire and Braehead at Glasgow comprise a long series now being further extended by the erection of the steel framework of Belvedere Power Station—another of the London Group.

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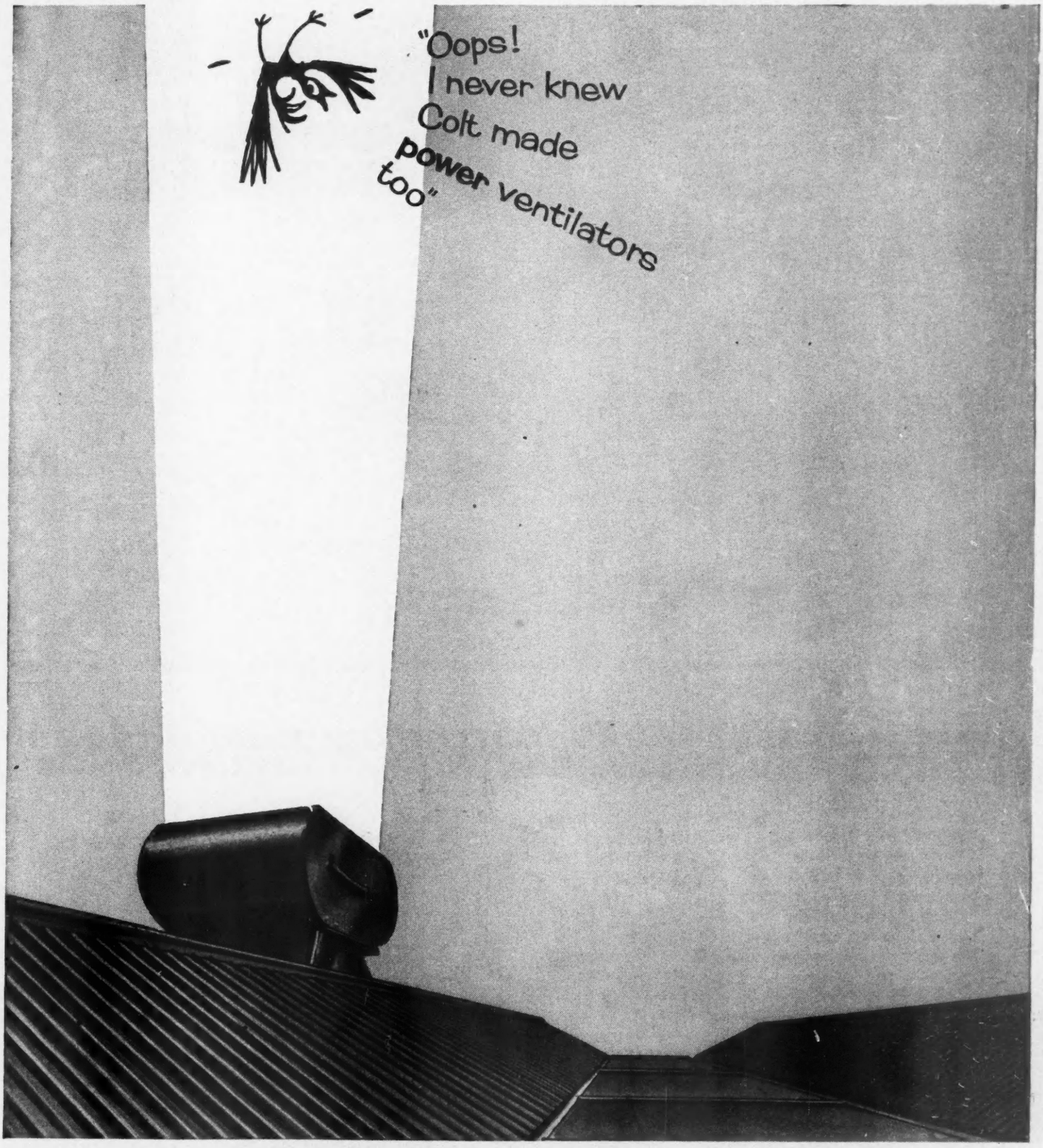


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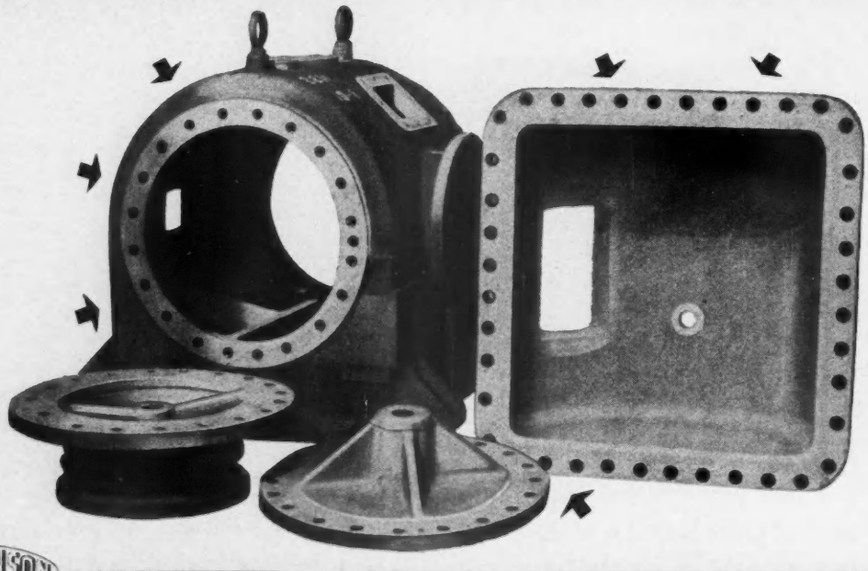

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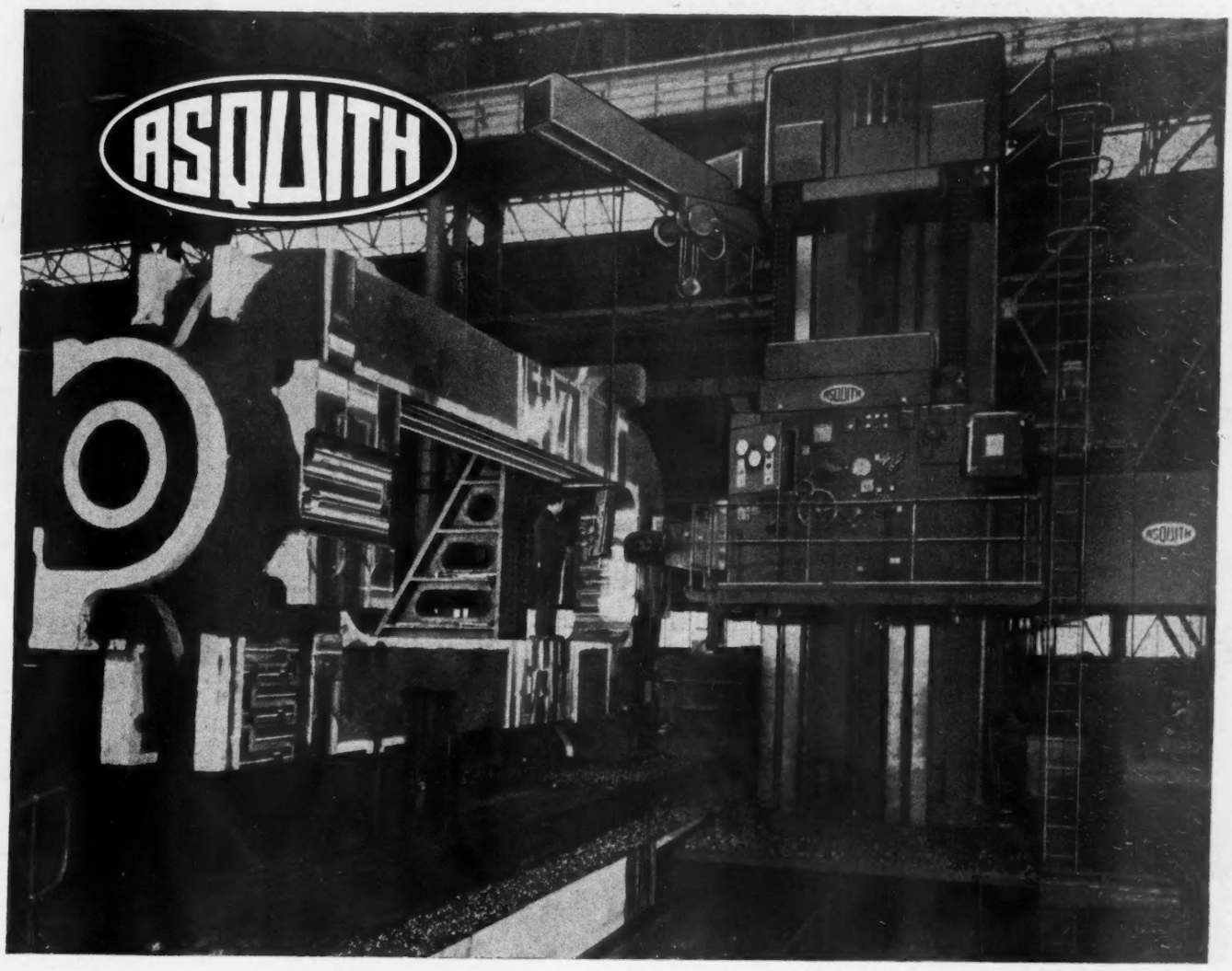


# RAM TYPE *Horizontal Milling & Boring Machine at* DAVY-UNITED

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The 10 in. Spindle Ram Type machine shown above is machining a 170-ton Mill Housing at the Darnall Works, Sheffield, of Davy and United Engineering Company Limited.

The exceptionally robust proportion of this Asquith machine can be appreciated from the illustration. A 28 in. by 36 in. ram houses the milling sleeve and spindle, both of which travel with the ram. The milling sleeve which carries the cutter is 23 in. dia. and attachments for right angle milling, etc., are also available for heavy duty work. Surfacing slides are available and when fitted obtain feed and hand adjustments from the slide of the machine, thus having all the features of built-in facing heads.

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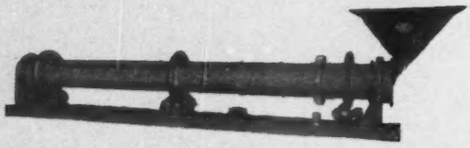

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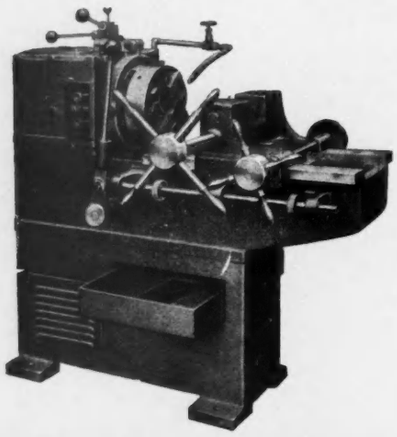

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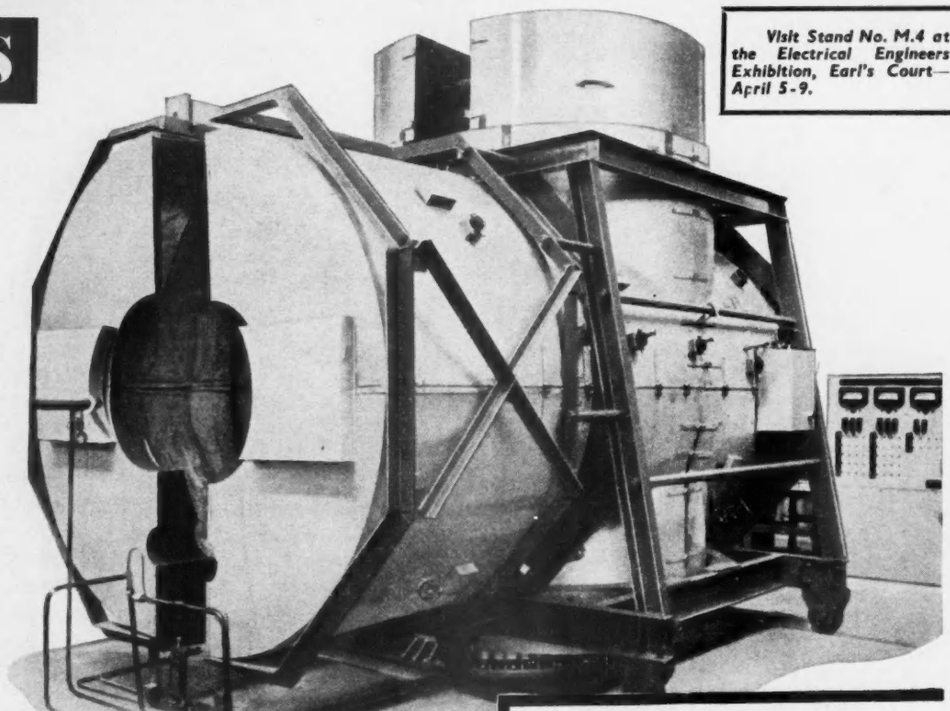

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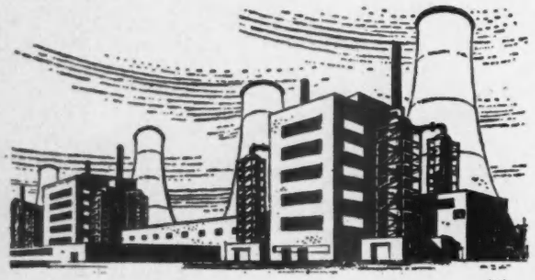
# Newalls

**Throughout the years Newalls have built an enviable reputation in the insulation of conventional power stations. This specialised experience is now being drawn upon on an ever growing scale in solving the complex problems of Nuclear Power Development. Recent contracts in this field reflecting Newalls supremacy are given below.**



**HINKLEY C.E.G.B. NUCLEAR POWER STATION**

At Hinkley Point, Newalls have been entrusted with the insulation of the reactors, steam raising units, gas ducting, integral piping, etc., under contract to Babcock and Wilcox Ltd.

**CHAPELCROSS U.K.A.E.A. NUCLEAR POWER STATION**

Under contract to Babcock and Wilcox Ltd., Newalls are carrying out the insulation of the 16 steam raising units and integral piping. The insulation of turbines, blowers, associated auxiliary equipment and piping is being carried out under contract to C. A. Parsons and Co. Ltd.

**BRADWELL C.E.G.B. NUCLEAR POWER STATION**

At Bradwell-on-Sea a further large contract for the thermal insulation of turbines, associated auxiliary equipment and piping (main and auxiliary turbine plants) has also been placed by C. A. Parsons and Co. Ltd with Newalls.

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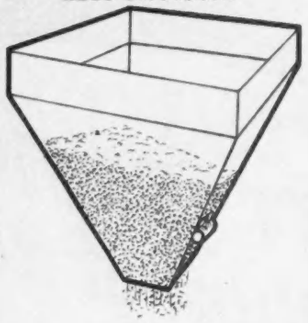
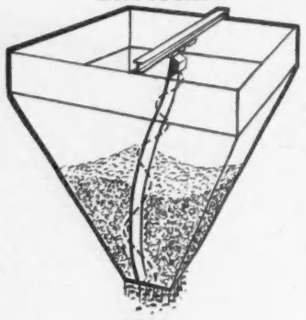
**LESS-DIFFICULT**



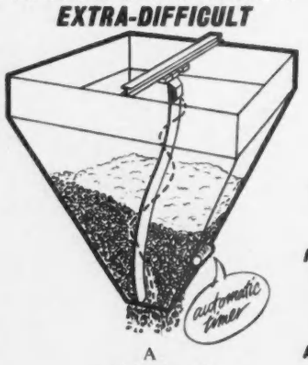
The installation of an external vibrator to a steel hopper.

**DIFFICULT**



The vibrating reed for application where external vibration is impractical due to structural or other difficulties and if the bunker is made of concrete.

**EXTRA-DIFFICULT**




A combination of internal and external bunker vibration. Where the external vibrator is timed for 'on and off', the vibration frequency, on slowing down, goes through the natural resonance of the bunker, irrespective of load material contained.

# trouble-free bunker discharge

The primitive, inefficient method commonly used for clearing material which sticks in a storage bunker is by applying a sledge hammer to the side of the hopper. This is a form of low frequency, uncontrolled vibration. When vibration is applied at the *correct* frequency, the *correct* amplitude and the *correct* point of application, almost any material can be satisfactorily discharged.

SINEX has the experience with a wide variety of materials and a wide range of hopper designs to recommend how vibration should be applied effectively to solve *your* particular problem.

The three examples illustrated show three different combinations which are typical of many applications, but even these, whilst using the same type of unit, can only be effective if the types of unit themselves are placed in the correct position and have the correct frequencies and amplitudes of vibration, to suit the characteristics of the material to be discharged.

It would pay you, therefore, to make use of our experience and to consult us on your particular problem.

Send for relevant details and information sheet.

These are some of the many materials which we have handled satisfactorily and ensured trouble-free bunker discharge: Pulverised and small coal, iron ore, coke, lime, flour, grain, grist, foundry sand, soda ash, cullet, sand, gravel, granite chips and all road stone materials.

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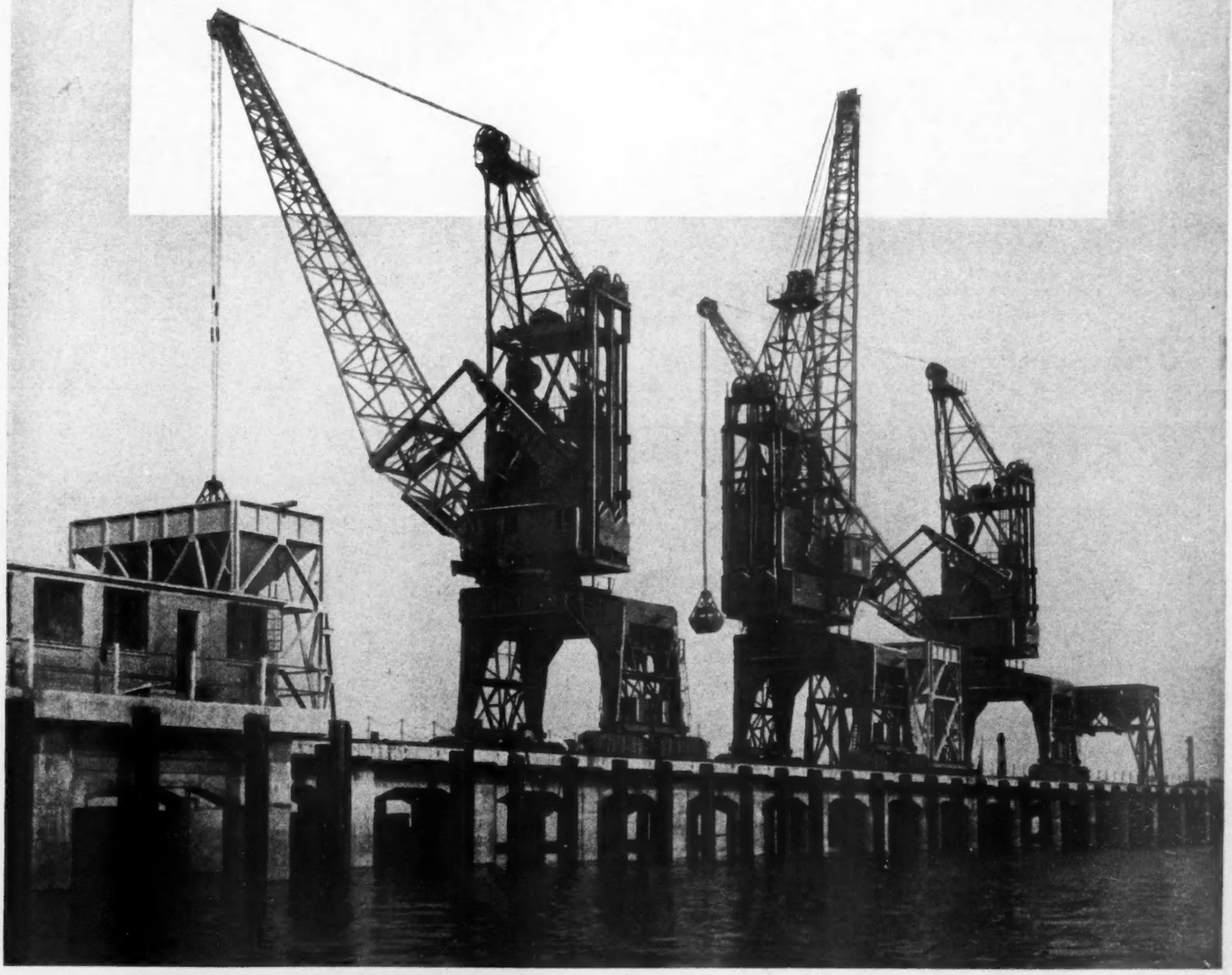

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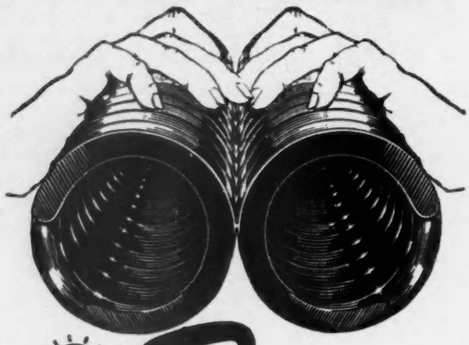
Looking in the right direction



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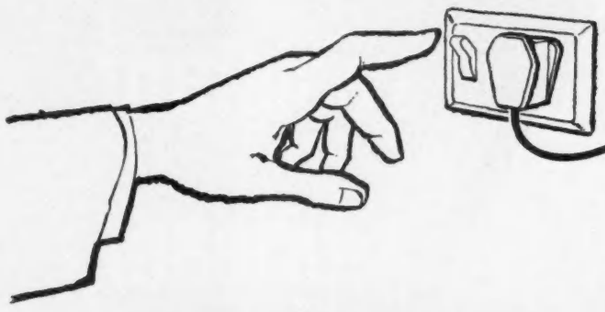
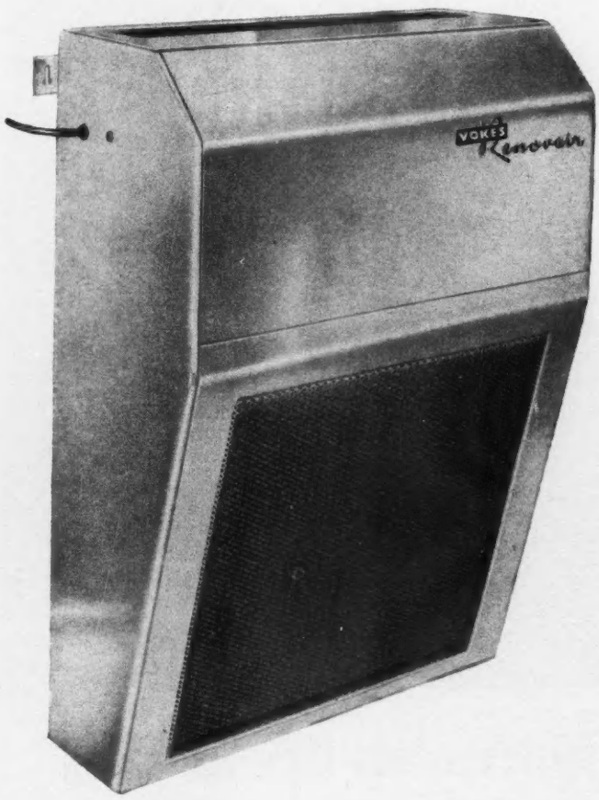
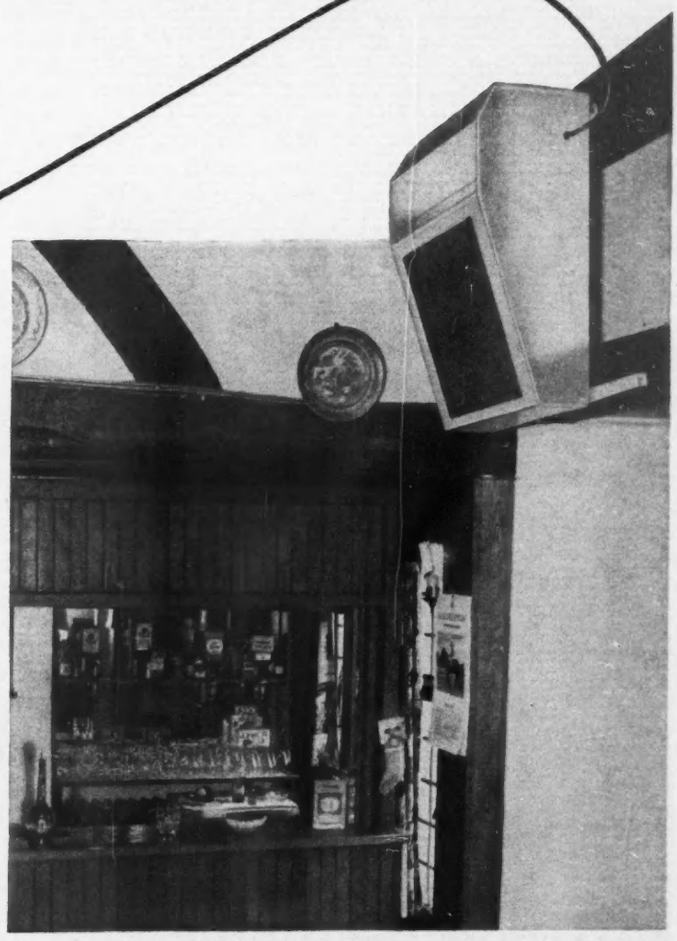
# Tobacco smoke disappears when the VOKES Renovair is switched on





Vokes' new Renovair is ideal for use in meeting halls, offices, restaurants or any building or room where people congregate. Simply switch it on and it immediately reduces the amount of tobacco smoke in the atmosphere, clearing it completely within a few minutes. Besides the obvious advantages to health, improved visibility and cleanliness, the use of a Renovair leads to enormous savings on the upkeep and renewal of furnishings and paintwork. In addition, because it *cleans* the air and re-circulates it, heat loss is eliminated and heating bills are considerably reduced.

**COMPLETELY SELF-CONTAINED**

The Renovair consists of a Vokes 'Absolute' filter of guaranteed and proved efficiency, a fan, a motor, and an acoustic chamber to ensure quiet operation—all mounted in an attractive robust cabinet suitable for floor or wall mounting.

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V530

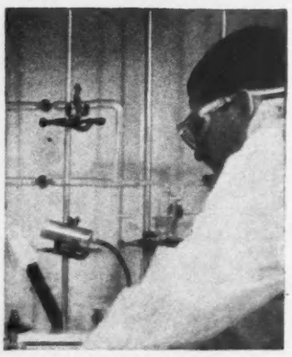
# nucleol

# radiation resistant lubricants for the atomic age

## A range developed and perfected by Wakefield-Dick Research

Conventional oils cannot live in conditions of atomic radiation. Such conditions are inseparable from certain parts of any mechanism designed to produce power from nuclear fission. This, and other allied lubrication problems, was the challenge which faced oil technologists everywhere. And, as so often in the past, Wakefield-Dick's research team produced the answer. An entirely new series of oils and greases, resistant to radiation and named "Nucleol", is now available to lubricate the wheels of this Atomic Age.

INDUSTRIAL WAKEFIELD-DICK LUBRICANTS



*A Wakefield-Dick research chemist investigating the effects of radiation on lubricants.*

### Two examples of the NUCLEOL range

**NUCLEOL 522** A radiation resistant lubricant based on selected mineral oils of high aromaticity and containing special inhibitors.

**NUCLEOL G129** A grease gelled with a new compound, and specially inhibited. Designed for the lubrication of control actuator bearings operating at the lower radiation levels.

# ENGINEERING Impact

## of Computer Research upon Traffic Flow

The time setting of some traffic signals is already being adjusted to conform with the results obtained by special studies of signal lights and traffic flow carried out by Dr. Francis Webster of the Road Research Laboratory.

Equivalents for the working of signals and vehicle movements through a controlled intersection were investigated with a computer. Practical road checks were carried out on the formula for average vehicle delay which was obtained.

For maximum flow and layout experiments the principal factors were taken to be the proportion of goods vehicles, the proportion of right-turning traffic and the amount of parking on the approaches. The outcome is that a figure of average delay to vehicles can be determined and the traffic capacity of a controlled road junction estimated.

A more valid way of comparing the benefits to traffic of alternative road improvements can now be used. New intersections can be designed for the expected volume of traffic.

The findings of Dr. Webster's team in relation to roundabouts reverses a favourite dogma of many motorists. Two roundabouts were investigated. Both suffered from jamming at peak periods. The results indicated that the introduction of signals to previously uncontrolled roundabouts allows more traffic to pass and improves driving conditions.

Earlier thinking on signals is at fault when intersection approach speeds rise as high as modern motorway use makes usual. Following investigation by Dr. Webster a new signal controller is being developed that will hold the light at green until the vehicle which has passed the point at which it can no longer safely stop is across the junction.

Dr. Webster has been awarded the £500 Wolfe Award for 1959, which is given for outstanding contribution to the work of the DSIR.

## Work Study Bristol Fashion

Some of the successes achieved by work study in the Royal Navy may be useful guides, as well as something of a relief, to the companies and individual taxpayers who maintain that costly body.

Fleet work study teams have now completed more than 90 investigations, from torpedo loading drill to ship's office methods.

On an aircraft carrier it was found that, whether at sea or in harbour, six or seven men could usually be found waiting outside the engineer's ready-use store. Small alterations to layout and stores methods cut out three-quarters of this standing around.

At a Royal Naval Air Station the number of drivers was reduced by 13 (almost 30 per cent), four vehicles were surrendered as not needed, and more and better maintenance was done, with less overtime.

One of the most interesting results was with the intermediate dockings of submarines. Reducing the time for this periodic operation from two weeks to one, by carrying out dockings during leave periods, and by cutting out the third such docking, the work study team improved operational ability in the submarine fleet by the equivalent of three more submarines.

Students of Parkinson's Law, who regard the Admiralty as a showcase of exhibits which might almost have been established for demonstration purposes, will be wondering whether the study teams will be showing up at headquarters.

## Pipelines and Power Stations

If and when political advance in Algeria goes forward far enough for long term exploitation of the oil and natural gas resources to be carried out there will be an interesting problem of priorities.

The most expensive system of those envisaged is one of land pipelines from Bou-Hassid to Mostaganem on the coast and then submarine pipelines to Cartagena in Spain. If it were to be built today the cost is estimated at about £60,000,000, the equivalent to the cost of building a 600 MW nuclear power station.

A gas duct from these sources would carry some 7,000 million cu. metres of natural gas to Europe a year—with an energy equivalent many times that of a 600 MW power station.

Some qualifications about the price advantage in Europe of oil and natural gas from across the Mediterranean are beginning to be advanced. Recent pronouncements from General de Gaulle suggesting prolonged campaigns of attrition in Algeria throw before them the suggestion that the cost of subduing the Algerian nationalists will be reflected in higher prices asked for oil and natural gas from North Africa.

## Problems of European Steel

The troubles of the coal industry in the European Coal and Steel Community are well known. What has been happening to the Community's other product? The short answer is that steel has also had its difficulties. The first of these concerns scrap, which the High Authority would like to see less used. The price of both Community and American scrap has now reached some $40 a ton. Some Italian and French producers are asking for a scheme to be reintroduced which evens out prices of scrap over the six member countries. This was especially popular in Italy which is traditionally short of scrap.

With a possible shortage of scrap ahead the High Authority wants steelmakers to use more pig iron. So far there is no great eagerness to comply. The second steel problem is a by-product of the devaluation of the French franc. The High Authority has asked the French Government, so far without any success, to impose a 4 per cent duty on Bessemer steel exports to counteract the price advantage due to devaluation.

The most serious problem, however, is the proposed merger of August-Thyssen Hütte and Phoenix-Rheinrohr —which would result in a group producing 9 per cent of ECSC steel output.

The proposal will probably be approved but with strings attached. The danger is that this may set off new merger proposals—and more trouble for the High Authority.

## of Being Mach-Minded

People will flock almost anywhere, even Miami, provided they can be got there within twelve hours; but if the journey takes more than that, only the occasional unwary businessman can be caught by the airlines. But it was precisely the self-punishing businessman who opened up the great trade routes and forced the demand for cheaper, faster, mass transport. It is the airlines' mission to extend the twelve-hour limit to girdle the entire globe.

The thesis was developed by Sir George Edwards last week in a joint lecture to the graduates and students sections of the engineering institutions with much vigour, clarity and a great deal of entertainment value. That in the process some facts got knocked down by the slipstream of his logic is a result of being too aeroplane minded, a quality that has made Sir George one of the most honoured aircraft men in the world.

Putting air transport firmly into its sphere of influence, Sir George dismissed ships and rail saying that "surface transport clearly has its limitations," and pointed to 30 and 90 miles per hour as the top speeds attainable. But the only real limitation of surface speed is money, the railways and passenger ships not having benefited from Government contracts to the same extent as the aircraft industry. In America there are Mach 1 rocket sleds in operation and as far as one can tell have an excellent safety record; while the speed of submarines is no more limited than the speed of aircraft was 20 years ago.

Sir George pointed to the Mach 2·2 airliner, the fastest light-metal plane, as the means to bring London and Sydney almost within the magic twelve-hour limit. But in fact the limit will be extended only to ten out of sixty million people in the two countries who live within easy reach of the airport. If as Sir George suggests, the airlines' business and mission is to extend the twelve-hour limit to as many "person-miles" as possible, a supreme effort to improve feeder transport must have priority over Mach 2·2.

Rocket sleds, anyone?

## What is a Commanding Height ?

The Labour Party now has the unrevised Clause Four of the 1918 constitution among its aims and for good measure Mr. Gaitskell's reaffirming, clarifying and amplifying statement of aims incorporating the substantial expansion of public ownership and using Aneurin Bevan's phrase about power over the commanding heights of the economy.

In the day to day administration of the United Kingdom the Labour Party may now turn outwards from itself and engage the Government again as an active Opposition.

In the longer run the decision of last week's National Executive must have an effect upon the possible future impact of a Labour administration upon industry. The wilderness years of the party from 1951 onwards saw its nationalisation proposals reduced to the renationalisation of steel and road transport and the threat to the 600 major companies of being taken over if they were "failing the nation."

Condemned to another sentence of Opposition the Labour Party has another period for rethinking and if the net is cast widely enough it is possible to find members who argue in favour of public ownership of the car industry, chemicals, aviation, parts of the financial organisation, machine tools, housing of course was a part of the last official election programme, and much else besides.

The commanding heights phrase has as many meanings as there are peaks in the Lake District. In an affluent society the advertising firms command considerable influence over the economy. So do other non-industrial media. The commanding heights of the economy are not solely the banks and heavy industry as they may have been seen to be, say, in the formative years of Mr. Bevan.

The new statement of aims also includes expansion of power over the State owned industries.

If this means accountability to Parliament of the great State boards then it will be welcome.

## and Whitworth versus United Standard

Diversification, the spreading of a firm's capacity over as many fields as possible, is a feature of current industrial development. At the same time variety reduction, the elimination of needless diversity among the products or components made to meet a particular demand is gaining increased attention.

The recommendations of Sir Ernest Lemon's committee ten years ago, that variety in many branches of engineering production could be reduced with benefit to the manufacturer and others associated with him, have only slowly been taken up. As it becomes increasingly necessary for every item of capital investment and every pound spent to be used with the least waste so the economic pressure of competition is likely to take a hand in promoting greater standardisation.

War time gains in the use in this country of the American United Standard Threads have not been followed through and all the export propaganda of fifteen years has not persuaded large numbers of British firms to go over from the traditional United Kingdom Whitworth thread.

It is still the boast of some firms, and trade associations, that instead of producing their products in standard ranges at lower prices they will manufacture precisely to the customers' specification. This may keep most of the old clients. It is no way to go about finding new.

Easier training of workpeople, greater safety, mobility of labour, easier interchangeability of parts, lower first costs and replacement costs—variety reduction has a long list of attractions to explain the attention now being paid to it.

# Good Looks and Protection by Metallising

**Metallising is striding forward. Continuously coated decorative film can now compete with laminated foil, and protective coatings are improving.**

Vacuum metallising is a coating process. True, it is a method which has been practised since the middle thirties, but it is only recently that two advances have been made which promise to popularise the process. These are the development of air to air seals, and of sources of metal vapour with long life and high output. Between them they will enable paper and plastic film to be coated continuously and so be competitive with laminated foils, and also enable thick films to be built up, especially on metals, for corrosion resistance.

The basic idea is to have a vacuum, a hot source of metal vapour, and a cold item to be plated called the substrate. The prerequisite for obtaining uniform, adherent deposits is that the substrate is clean, dry, stable and will not outgas when the vapour condenses on it. In Germany in the Second World War, metallised paper was coated with zinc because there is little difficulty in holding the molten metal. Cadmium and in fact any metal with high vapour pressure can be used for the coating, but by far the most popular is aluminium.

Dr. Alexander and Andrew de Dain were pioneers with aluminium, and following their work in 1936-1939 the process was widely used for making metallised paper for capacitors and for stamping foils. Undoubtedly the greatest potential use of metallising is for making foils in place of the laminating processes with eyes on the packaging and domestic insulation markets. Films can be paper or plastic. One firm particularly is active in making metallising equipment. They are Vacuum Research (Cambridge)—known as Camvac—who operate in close collaboration with the American company of Continental Can, and own jointly with them the British patenting company of Vacuum Metallizing Processes. Most of their equipment is destined for the American market but there is no reason at all why it should not be absorbed in the United Kingdom when interest is aroused.

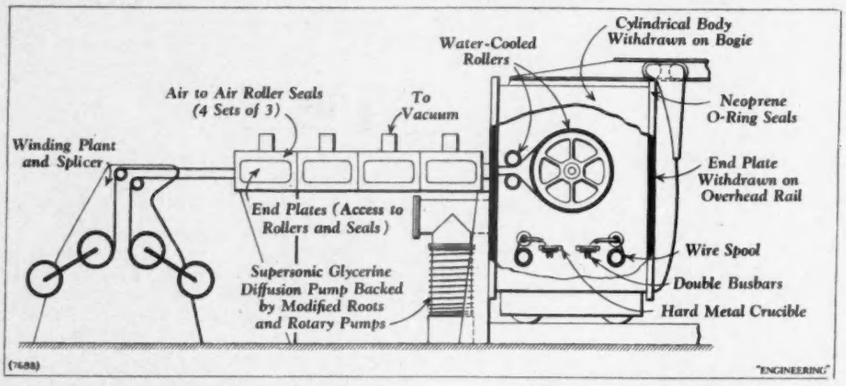
The latest effort of this company is in building a continuous metalliser for handling 42 in wide film at speeds of 12,000 yd per hour. For this, the maximum power requirement is about 250 kW. In spite of the higher capital cost of about £100,000 for a metalliser which turns out 2 tons a day, compared with £400,000 for a laminator with 15 times the capacity, the depreciation, running and labour costs tot up to only ¼*d* a sq. yd, which is really competitive.

Aluminium coatings on foil are typically $7 \times 10^{-6}$ cm thick—only a few atoms—but a major advance by National Research Corporation in America has been deposition of adherent films of aluminium and cadmium up to 0·002 in thick. Such deposits could then compete with sprayed metal, dipped metal coats and electroplates, and it looks as though the special properties of the coatings will more than offset the higher price.

Metallisers are batch, semicontinuous or continuous. In the first two, the material to be coated is contained either on rotating jigs or on rolls which are wholly in the vacuum chamber. Continuous metallisers employ two air to vacuum seals (equal one air to air seal). Such seals are difficult enough to make for strip, so it will be a few years before there are continuous metallisers for such items as castings and sheet metal stampings.

Now to the other great difficulty—the vapour source; this ogre is fast disappearing, but only after a fight. Alexander's metallisers employed a tungsten rod filament heated by electrical resistance on to which was fed aluminium. This wetted the surface and evaporated. It also destroyed the tungsten filament. Following attempts were with crucibles heated in the same way, but made typically of graphite with say a boride coating. Most successful to date are hard metal mixtures which will withstand molten aluminium for over 8 hours at 1,500° C. This is far longer than is required to cover an average roll of film in the semicontinuous arrangement where, in any event, a stop every 90 minutes to change the roll limits utilisation of the plant to about 25 per cent.

Increases in vapourising capacity are impressive; with a tungsten filament 1·8 lb of aluminium could be evaporated in a multi-element machine; with coated graphite, 8·5 lb; and with hard metals, 140 lb. The evaporation rate now achieved by NRC in such crucibles is 0·0017 lb a sq. in-min.


Cylindrical Body Withdrawn on Bogie
Water-Cooled Rollers
Air to Air Roller Seals (4 Sets of 3)
To Vacuum
Neoprene O-Ring Seals
Winding Plant and Splicer
End Plate Withdrawn on Overhead Rail
End Plates (Access to Rollers and Seals)
Wire Spool
Supersonic Glycerine Diffusion Pump Backed by Modified Roots and Rotary Pumps
Double Busbars
Hard Metal Crucible
"ENGINEERING"

*Diagrammatic workings of a plant for continuously metallising plastic and paper film on one side only at speeds up to 12,000 yd per hr. (Camvac).*

On foil, the thinness of the metal film means that many properties of the substrate are retained in the metallised material; for instance, handling properties are seldom impaired. The vapour barrier properties of plain materials are only increased to a small extent, except with polyester film such as Melinex where there is a ten-fold improvement. Heat reflectivity is 96 per cent compared with 97 per cent with an aluminium foil. Surface defects are emphasised. The way to obtain specular reflection is to deposit on to a mirror finish which can be obtained by polishing or lacquering before metallisation. Metallising on the "inside" is used on transparent roll films and batch coated plastic mouldings such as for dashboards, horn buttons and tail lights.

Now to the vacuum, and designing to maintain it at the typical figure of $10^{-3}$ mm of Hg. The enemy are shaft seals, windows, access covers, air to air seals and materials like cellophane which insist on releasing plasticisers and water vapours when hot metal condenses on them in spite of the fact that they are running on water cooled rollers. The answer is know-how (which means neoprene O-rings, super-finished seats, leaktight welding and rotary seals of the Wilson type) and plenty of pumping capacity, especially at the pressures at which degassing occurs. Camvac make use of a patented booster-type diffusion pump with a supersonic jet of glycerine vapour, backed by a double-speed Roots exhauster, and a straightforward rotary roughing pump.

Many air to air seals have been proposed, many have failed. Camvac make one which works. This consists of sets of rollers mounted between rigidly mounted side plates with a double rotary seal at each end. A seal is maintained between the moving rollers and the top and bottom walls. Between pairs of rollers passes the web of film, which has carefully controlled width so that when centred through the rollers, only a small slit is left between the edges and the vertical walls. There are four chambers, each containing three sets of rollers, and in each set two seal the in-going web while two seal the out-going web. The rollers are positioned so that they will accept splices and dimensional changes without tearing the web, and the vacuum machinery is of sufficient capacity to prevent damaging pressure build-ups in the plant even if the web breaks and runs through.

Aluminium used for coatings may be either commercial quality (1050) or superpurity (99·99 per cent), although the latter sometimes does not wet the crucible readily. NRC, who claim to have continuously coated paper, plastics and mild steel on pilot scale plant, are prepared to deposit different compositions in different thicknesses on both sides simultaneously. On mild steel they have laid down thick coatings for corrosion resistance, rather than decoration, which, at a thickness of 15 micro-in, have shown corrosion resistance comparable with a quarter lb tinplate. Such coated strip serves as a good base for enamelling and lithographing.

With the development of large capacity vapour sources, NRC have been able to batch produce reproducible thick coatings with some hope of commercial exploitation, and Vacuum Metallising Processes hold many patents in this field. The first applications appear to be for protecting high tensile structures in aircraft, particularly those exposed to marine atmospheres. Many advantages are claimed for metallised deposits; there is no slag entrapment compared with hot dipped coatings; no hydrogen embrittlement as in plating; metallising temperatures are held low so there is no alloying before going into service; the coatings are dense, therefore require no heat treatment; there are no oxide inclusions; and fatigue and tensile strength of the substrate are unimpaired.

Coatings of aluminium have been deposited in thicknesses ranging from 0·1 mil to several mils on many metallic bases, from a mild steel (1030) to a high alloy steel (Vascojet 1000); also on aluminium, magnesium, and titanium alloys. Strengths of AISI 8740 and Vascojet 1000, heat treated to yield strengths of 190,000 and 220,000 lb per sq. in respectively, were retained after depositing 1 mil of aluminium on them. In corrosion tests, 0·002 in of aluminium on Vascojet 1000 has withstood 1,600 hours in 20 per cent salt spray at 35° C. Further evidence of outstanding corrosion resistance is an automobile bumper coated with thick aluminium which has been driven for 2 years with no evidence of corrosion.

The above article includes, with their permission, a text submitted by Mr. P. J. Clough and Mr. H. M. Farrow, on metallising activities at NRC, Cambridge, Massachusetts, USA.

## Pvc-coated Steel and Plastic Laminates

Stelvetite, the pvc-coated steel made by John Summers and Sons, is being used for ventilation ducting inside a 270 ft tall stack at the National Smelting Company's works at Avonmouth. The pvc coating is on the inside and comes into contact with traces of acidity. On the outer side is a thick epoxy coating applied by Parglas. This resists traces of ammonia in the surrounding atmosphere. The structure forms part of the new beryllium extraction plant which has been in production since November, 1959.

This combination of epoxy resin with pvc coated steel is only one of the variations in making corrosion resistant laminates. Pvc has been used on its own as typified by the installation of fume ducting which is installed at the National Chemical Laboratory (see ENGNG., 2 Oct. '59, p. 292). Then glass reinforced epoxy has been used at the National Smelting Company's works to resist sulphur dioxide fumes.

The idea of reinforcing a thin pvc film with a glass polyester laminate has been exploited by Cawley Plastics in their material called Tufplas (see ENGNG., 16 Oct. '59, p. 356).

Parglas, of Bristol, suggested using Stelvetite for the ducting first mentioned. The steel backing provides rigidity, but in this case requires protection on the reverse side. Epoxy coatings, which can be used in similar form for reinforced plastics, are ideal for this because of their high adhesion to steel. Note, though, that it may pay to use one of the steel laminates which are precoated with tin or zinc even when protected with epoxies. The makers of such strip are to be found in ENGNG., 18 Mar. '60, p. 374.

## Drawing Material

An all rag, semi-translucent paper called Superdraft, has a clean white surface for draughtsmen to work on and provides a good contrast for micro-filming. Made by Hall Harding, it is available in two weights, 63 gm (A) and 53 gm (B), in rolls 30 and 40 in wide by 50 yd long, and in cut sheets plain or printed to pattern. Photocopying can be performed with the heavier grade with high intensity light sources, but most medium or low power copiers can be used for the lighter grade.

*Hall Harding Limited, Stourton House, Dacre Street, London, SW1.*

## Plastic Coatings

How is plastic applied to metal articles to improve corrosion and abrasion resistance? For coatings produced continuously on strip, see ENGNG., 18 March, '60 pp. 374-5. In this, however, there is no mention of coatings applied by dipping a hot metal article in a fluidised suspension of plastics powder in air, and in this field there are many advances being made. Telegraph Construction and Maintenance Company are the sole licencees of the German patents in this country; in America, the Whirlclad Division of Polymer Corporation is exploiting the process.

The fluidised powder dipping process can be applied to a wide range of plastics, including thermosetting ones if the powder is partially uncured before dipping. Thus Whirlclad will coat with cellulosic plastics, pvc, nylon, polyethylene, chlorinated polyether and epoxies. Telcon have cellulose aceto-butyrate, high and low density polyethylene powders, ptfe, are presently working on nylon and epoxies, and have just launched a pvc powder called Telcovin A. This is a lightly plasticised pvc powder which will withstand temperatures up to about 105° C, but the company are bringing out other grades which are more highly plasticised.

No firm is yet known to be continuously coating strip by passing the preheated strip through a fluidised bed of pvc, but this method could undoubtedly be used, and would avoid the task of calendering pvc sheet for the laminating process, and of needlessly diluting with plasticisers in order to apply as a plastisol coating by roller or spray.

If the plastisol dipping process is older than fluidised processes, it certainly is not past its prime. British Geon report what is thought to be the heaviest dip-coated article in the world which was recently completed for the Esso refinery at Fawley. As shown in the illustration, it is the casing of a 30-24 in horizontal D.S. pump supplying the main salt water delivery for cooling. Maximum capacity of the pump is 22,000 gallons per min.

The pump casing consists of two parts together weighing 4½ tons. Durable Plastics, of Guildford, who have recently commissioned a plant able to coat articles up to 5 tons in weight and

*Pump casing dipped in pvc plastisol.*

17 × 7 × 7 ft in size, undertook the work. The pvc paste was one made by British Geon and allowed a coating $\frac{3}{16}$ in thick to be produced. This experimental anti corrosive coating is being tried in place of a sprayed neoprene coating, used formerly. The cost in this instance was cut 50 per cent in the changeover.

*Telegraph Construction and Maintenance Company Limited, Greenwich, London, SE10.*
*British Geon Limited, Devonshire House, Piccadilly, London, W1.*

## Turbine and Bolting Uses for New 12 Cr-Steels

Jethete steels have been in production for about three years and user experience is being gained which shows that they are particularly promising for sheet metal pressings and turbine blading in the aircraft and missile fields. Interest is also being shown by makers of blading for low pressure steam turbines and two of the alloys are being used or considered for high temperature bolting.

Development has been carried out jointly by United Steel Companies Research and Development, and Samuel Fox—the starting material being a low carbon 12Cr-stainless steel. The aim has been to improve the strength and tempering resistance of this alloy. It is transformable from high temperature austenite into temperable martensite, but has to be stabilised to prevent formation of ferrite during quenching. This could be done, incidentally, by increasing carbon, but only at the expense of reducing its impact strength and making it difficult to weld satisfactorily. Compositions are as follows and are compared with AISI 403 and 414 with which they will compete for turbine blading.

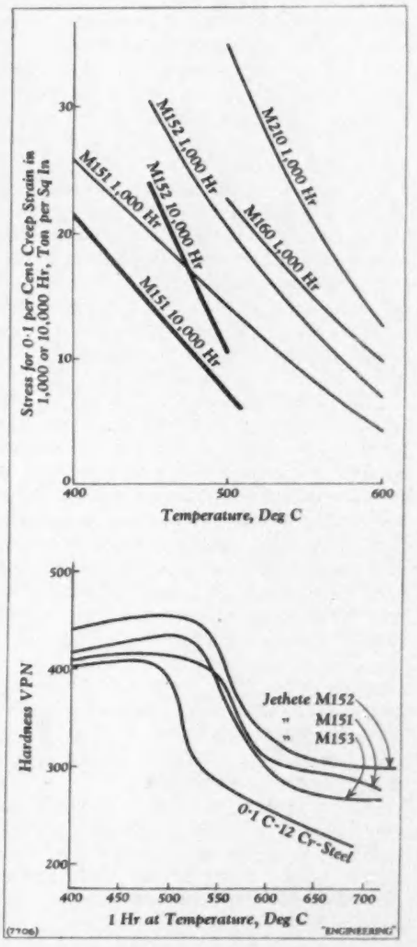
The creep strength of these alloys is good at elevated temperature as is shown in the illustration (for average strain rates of $10^{-6}$ and $10^{-7}$ per hour). The mechanical properties of Jethete steels are considerably better than types 403 and 414 steels, states USC. This is because they have molybdenum and vanadium additions which give them better tempering resistance and hence better tensile properties at any one tempering

| | C | Mn | Si | Ni | Cr | Mo | V | Others |
|---|---|---|---|---|---|---|---|---|
| M151 | 0·10 | 1·5 | 0·30 | 1·3 | 12·0 | 0·60 | 0·35 | — |
| M152 | 0·12 | 0·70 | 0·30 | 2·4 | 12·0 | 1·7 | 0·35 | — |
| M153 | 0·10 | 1·4 | 0·30 | 1·5 | 12·0 | 1·3 | — | — |
| M160 | 0·14 | 0·95 | 0·30 | 1·0 | 12·0 | 0·60 | 0·30 | 0·25 Nb |
| M210 | Analysis not published .. | | | | | but includes Co, B | | |
| 403 | 0·15 | 1·0 | 0·50 | — | 12·0 | — | — | — |
| 414 | 0·15 | 1·0 | 1·0 | 1·8 | 12·0 | — | — | — |

*Compositions of Jethete Steels, 403 and 414*

treatment. M152, in particular, has much higher impact properties.

The major use of M151 is in sheet form where




it is capable of softening for fabrication by pressing, followed by simple solution and tempering heat treatments to obtain optimum mechanical properties. Applications include gas turbine engine casings and rings and ancillary pressings.

M152 is a development of M151 with higher impact strength and low transition temperature. It competes with M151 for the outlets mentioned above, but has also been used for low pressure steam turbine blades on two important contracts. M153 is a lower cost but high impact version of M152 with main outlets on the secret list in Dreadnought.

Niobium improves the high temperature strength of M160 still further over that of M151 and M152, as is needed for aircraft gas turbine blades. M210 contains cobalt and boron and is one of still more alloys which are being developed with high strength at elevated temperatures.

*United Steel Companies Limited, PO Box 64, Sheffield 10.*

# Plain Words

*By Capricorn*

My sympathy is with the man whose invention misfires. I have no time for the know-alls who are wise after the event.

It is a mortifying experience to see your brain-child, on which you had built such high hopes, suddenly reveal unexpected weaknesses. It is a cruel experience if the failure occurs in front of the public or in front of a critical, expert audience. Old-established engineering firms can usually avoid such disgraces because even their brightest inventions and developments have to run the gauntlet past critics and committees. The firm that builds the Best Car in the World can send a prototype to France and give it a good thrashing on the Continental roads before they unveil it to buyers.

But not all engineers are so fortunately placed. A senior railway engineer to whom I was talking recently pointed out to me that with a locomotive there was only one adequate way of testing it, and that was to put it into traffic, but the operating department and the travelling public were not very pleased when there was trouble on the line and the train had to be stopped.

I have never been responsible for commissioning a large process plant but I am told by folk who have that on those occasions something unexpected always happens. A valve is opened and steam comes out where water had been expected. The most complex part of the plant behaves perfectly but some wretchedly simple component goes on strike.

Of all engineers who have suffered in this way my heart goes out to two types in particular: the one for whom the trouble means the end of all financial backing because everyone suddenly gets cold feet; and, oddly enough, the one who has enjoyed a longish spell of commercial success with his invention but is then suddenly dashed to the ground by an unsuspected failure.

Quite a number of valuable developments may have been given up because no one could see a way to restore confidence at the critical stage. Some of the developments that have thus fallen by the wayside have been revived later, but often too late.

The man who enjoys success for a while, until his design quite suddenly lets him down, is doubly wounded. He is hit directly, and —even harder to bear—the staff he has built up to exploit his original efforts are in danger of earning much less or even losing their jobs. Fate dealt hardly, I think, with some at least of the drip-feed oil heater manufacturers. Their stoves have been the cause of fewer fires than the conventional coal fire, yet they have had to take a sudden tide of criticism and mistrust.

My sympathy, I said earlier, is with the man whose invention misfires. The oil-stove scare, however, has reminded me that I am likely to change my attitude when the unlucky one is my competitor. As one golfer said to the other who sliced his drive: "I'm afraid its gone in the rough . . . I hope."

## Letters to the Editor

### Oil Heaters

SIR, In reply to your At Home article (ENGNG., 18 Mar. '60, p. 404), may I hasten to assure the writer and your readers that the new British Standard for domestic oil heaters—shortly to be published—will most certainly conflict with the specification drawn up by the British Safety Council.

The most important difference will be the inclusion of a test to ensure safety against draughts of up to 17 to 18 miles per hour. This requirement is in accordance with the recommendations of the Department of Scientific and Industrial Research and was accepted by the whole of the British Standards Institution committee, including heater manufacturers, which is responsible for drafting the new British Standard.

The new standard forms the cornerstone on which Government policy on this matter is based. The Oil Appliance Manufacturers' Association, whose members account for the vast bulk of production of oil heaters, have already undertaken that their member firms will comply with the new standard, which will, of course, be a comprehensive specification containing many other safety features in addition to the provision guarding against the danger of draughts.

It is generally felt that compliance with this standard—especially combined with widespread use of the Institution's "Kite Mark"—is the most direct and sure way of quickly restoring public confidence in oil heaters.

Yours faithfully,
C. DOUGLAS WOODWARD,
Press and Public Relations Officer.

British Standards Institution,
2 Park Street,
London, W1.
23 March, 1960.

### Fads and Fallacies

SIR, In his interesting review of *Fad and Fallacies in the Name of Science*, Professor R. O. Kapp writes "Among other creeds discussed and, I think, successfully exposed are . . . extra-sensory perception . . ." and later, "many scientists may well think that Gardner has been misguided in his selection . . . call him unjustly critical . . . of extra-sensory perception" (ENGNG., 18 Mar. '60, p. 394). How an examination of such a complicated subject can be made adequately in what is necessarily a restricted space, is difficult to appreciate.

It is not out of place, however, in an engineering journal to comment on these remarks on a field which has been the subject of much serious research by psychologists such as McDougall and Rhine and by the Society for Psychical Research. The physical scientist has to examine phenomena which can be largely controlled and therefore the causal factors can be ascertained: the biologist, and more frequently the psychologist, has to examine phenomena from a multi-causal situation in which even the process of observation can be held suspect.

For reasons of multi-causality and difficulties associated with imposing controls on the causes (if known), statistical methods have to be used in analysing results. These frequently restrict the analyst to small samples, if time is limited, or, if large samples are required, to some years of observation, in order to obtain sufficient evidence to confirm or refute a particular hypothesis.

In the case of extra-sensory perception there is some reason to think that the phenomena (if they occur), may be short term, and it is not known what the causal factors are (although like-twin and sibling relationships are held to be conducive to it), so that it is extremely difficult to obtain evidence *for or against*, which would stand up to the normal requirements of verification of a hypothesis in the physical sciences. One is then rather left to a personal judgment (which may be biassed), but Dr. West of the Psychical Research Society said recently that he thought that there was something which could not be explained by normal processes.

The relevance of this for engineers is, to my mind, that the statistical reasoning and the detached observation required in a multi-causal situation, is that also required for studying industrial management processes, and this differs greatly from the normal approach in the physical sciences. One reads frequently about various systems of management producing good or bad motivation of workers, but due to small samples, the difficulty of imposing controlled conditions and of making *objective* observation of worker behaviour, the hypotheses (to my biassed mind) often sound specious and special pleading.

Nevertheless, a manager (whether charge-hand or director), must get on with managing, whether his outlook is the one in fashion at a particular time or not, and I consider that a special problem is posed for those interested in industrial psychology, to examine scientific methodology applied to the verification of various management philosophies. Would Professor Kapp consider an examination of industrial myths a suitable subject for an engineering student to study as an education in scientific methodology?

Yours faithfully,
J. A. C. WILLIAMS.

The College of Aeronautical and Automobile Engineering,
Sydney Street, King's Road,
Chelsea, London, SW3.
25 March, 1960.

### Redress for Awkward Loads

SIR, I can agree with your correspondent, Mr. Dudley A. Baker (ENGNG., 18 Mar. '60, p. 377), that one can experience a thrill from seeing a heavy load being transported by road. It is, however, questionable whether this is the best method of doing it. Mr. Baker points out that oversize loads are not new on the highway, but that the impatient motorist is. Are we to understand from this that, in order to maintain our exports of heavy equipment, the private motorist is to be forced off the roads altogether?

Surely the most sensible and economic course of action is to provide a system of transport of sufficient gauge to take the heaviest loads, while at the same time satisfying as many of the needs of the community as possible? Such a system would be achieved at a tithe of the cost of the necessary roads by the adoption of the principle of water transport. Not only can the same power move 80 times the load on water as on the road, but a waterway on the scale of the proposed Grand Contour Canal would solve the country's seasonal water shortage problem, as well as increasing the facilities for inland boating and fishing.

The builders of the London to Birmingham motorway admit that it can only carry one-sixth of the possible traffic on the existing railway between the two cities. The potential tonnage that could be carried on a waterway using the same area of land as the motorway is probably as great again. As I implied in my previous letter to you on "Work for the Waterways" (ENGNG., 4 Mar. '60 p. 312), the transport of alternator stators, at about 300 tons the limiting factor in the production of more efficient turbo-alternators, is most unlikely to become possible by road, to any really greater extent than at present, within the foreseeable future; whereas, by a 27 ft waterway, items of the order of 50 times this size would be readily portable, if lifting tackle were available, or even possible.

The only feasible way out of the transport mess into which this country has, by inertia, got itself, is through the application of a realistic coordinating policy for transport, such as has consistently been advocated by this Association,

and, to a certain extent, by ENGINEERING itself.

I am, Sir, Your obedient servant,

M. J. MACFARLANE,
Honorary Joint Secretary.

Midlands Branch,
The Inland Waterways Association,
68 Crick Road, Rugby.
18 March, 1960.

## Earning Our Leisure

SIR, Cancer and Capricorn are the titles ascribed to two imaginary lines around the earth. The contributor of your Plain Words features has assumed the latter as his pseudonym but Capricorn is in the Southern Hemisphere and one wonders whether he has chosen this rather than "Cancer" in an endeavour to camouflage the strength of his occasional bite or in order to indicate that he views conditions in Britain from a distance sufficiently remote to enable him to gain a reasonable perspective!

In his column (ENGNG., 15 Jan. '60, p. 76), Capricorn refers to the recent improvements in camping facilities and proceeds to speculate whether or not such progress may indicate the development by imaginative engineering designers of things previously unthought of or considered impracticable. This raises an interesting point in respect of the humanities.

In Australia, wages have increased during recent years to an extent even exceeding that in most other countries, but it is quite usual for those whose interests are concerned to suggest that the cost of living has increased even more rapidly. This is merely untidy thinking, but it indicates a psychological outlook which is of vast importance to the national economy. The fallacy of the contention is amply demonstrated by the fact that the average wage earner today would consider that he was below the bread line if he did not own, or owe for, a car, refrigerator, television set, and so on, and it may well be asked whether such items constitute the cost of living or are merely refinements.

In other words, it is not so much the cost of living but the standard of living which has increased so extravagantly. Be that as it may, the fact remains that the emphasis in this country today is not so much on wages (except by way of compensation) as on reduced hours of labour and one may well speculate with Capricorn as to where it is all leading.

If we devote our energies to devising, and our income to purchasing, more and more amenities and then demand more leisure time in which to enjoy them, it may well happen that we will find that we have the whole of our time in which to enjoy them, but no income with which to purchase them.

Yours faithfully,

GERALD B. LINCOLNE.

Lincolne and Demaine,
Melbourne, Australia.
7 March, 1960.

## Concrete Strengths

SIR, Mr. A. G. A. Saul has raised several interesting points in his letter (ENGNG., 11 Mar. '60, p. 344). I hope that publication of his results will take place in the near future. His figure of 20 per cent increase in strength for boiled specimens over that expected from a maturity basis is of the same order as obtained by Mr. R. Narayanan at elevated temperatures. In my original paper (*Magazine of Concrete Research*, No. 22), I limited the range of the maturity law to below 100° F through lack of experimental evidence at higher temperatures and the knowledge that the chemical reactions in the hardening of cement were altered in some way nearer boiling point.

Mr. Narayanan's work was designed to throw light on the problem and he found that the law was followed up to approximately 150° F, which is a comparable temperature to Mr. Saul's 132° F (50° C). I have never thought the law to be applicable to the prediction of strengths from cubes subjected to high temperatures and tested at small maturities, as in accelerated tests. Obviously, there must be lower and upper limits of temperature and time outside which the chemical reactions differ in their actions; these limits have been given approximate values in my recent paper (ENGNG., 15 Jan. '60, p. 78) and in Narayanan's forthcoming one.

Yours sincerely,

J. M. PLOWMAN.

Brookman's Park, Hertfordshire.
14 March, 1960.

## The Way of the Wind

SIR, Mr. C. S. Durst, in his recent letter (ENGNG., 19 Feb. '60, p. 248), gives more details from Dr. Jane Meiklejohn's paper on the strong winds at Milfield, as well as further evidence from Dr. Meiklejohn herself, and, having studied the original paper, I now agree that the complete evidence rules out "rotor-streaming" as the cause of the phenomenon. My apologies to all concerned.

Nevertheless, even though I fell into the old trap of not checking a quotation against the original reference, my point still holds, that Mr. Durst, in his article "Duration of Wind Loading on Buildings" (ENGNG., 27 Nov. '59, p. 550), nowhere referred to winds on lee slopes, which are probably more common than valley winds and are often more damaging than those on windward slopes and summits. Indeed, I found some most useful evidence to that effect, based on world-wide experience of damage to trees, quoted by a forester, Mr. K. N. V. Townsend, in a discussion reported in the same *Quarterly Journal of the Royal Meteorological Society*, only 20 pages away from Dr. Meiklejohn's paper.

Yours faithfully,

PETER RIVERS.

Redwood, Waterside,
Marple, Cheshire.
20 March, 1960.

## Draughts in the Room

SIR, In your article "No-Draught Fires" (ENGNG., 15 Jan. '60, p. 108), the only fireplace which appears to contribute to the reduction of draughts is the one on the left of your illustrations.

Fires and chimneys require an air supply for two reasons: to enable the fire to burn (in the case of well grates), and to enable the chimney to carry away smoke and foul air. An excess of air in either case will give rise to over heating and fuel extravagance on the one hand, and draughts and chilling of the room on the other.

The former need is simple and the volume of air required quite small, it requires catering for only in the case of well grates. The latter need is where most troubles arise; here the chimney requires by far the greater volume of air to carry away smoke and fumes, but without causing draughts and yet ensuring a change of air within the room.

To achieve this, what is required is a controlled supply of air from below the floor to the chimney and, at the same time, leaving a small pull on the air of the room so as to ensure an oxygen supply within the room. This auxiliary supply is best drawn from the top of the internal door. It is the warmest air available and entering at high level it mixes with the warmest air of the room and is little noticed. This is a very important point so often overlooked especially by those who closely "draught proof" their rooms and yet expect the fire to burn, the chimney to be free from smoking, and the air condition to be satisfactory. It is quite out of the question. Doors should always be draught proofed at the bottom where the air is cold and at foot level.

Designing new fires is one thing, but catering for the vast number of existing draughty and, when draught proofed, smoky chimneys, is another. These troubles have largely been overcome by a pioneer company who market domed fireside ventilators which direct to the fire a controlled amount of air from beneath the floor, and by reason of their designed maximum capacity being inadequate for draught proofed rooms, they do ensure the supply of a small amount of extra air from the room before effective results are achievable.

This is a cheap means to considerable efficiency and those who build houses with solid floors should provide air ducts at each side of the fireplace.

Yours faithfully,

F. G. DICKINSON.

12 Hart Street, Henley-on-Thames.
12 March, 1960.

## Wash-Day in Australia

SIR, You have drawn attention to the fact that in Australia some local bylaws require that all houses *now* being built require a room set aside for laundry purposes (ENGNG., 25 Sept. '59, p. 268).

You will, perhaps, be interested to know how this bylaw came into being. The influx of migrants to this country brought to the notice of the natives strange and wonderful European habits, among them the inclination to "wash." Prior to the coming of these migrants (many from your own clean green shores), natives of this country set aside a billabong (pond to you) for the use of the household. There, in the early hours of morning, the household was wont to assemble, with the temperature already in the nineties and climbing steadily. Mother, fully clothed, took a header into the treacherous billabong, thus scaring away deadly water snakes and the inevitable bunyip lurking in the shadows. Father and children followed unwillingly. (It was ever thus!) A few moments, then stretched out (wet and clothed) on the nearby sunbaked rocks, steam rising furiously from drenched clothing, and "wash-day" was over.

For the sake of that accuracy and attention to every detail with which you like to fill the pages of your exhilarating journal (I'm only the engineer's wife), I should like to point out that these migrants, who so changed our way of life, followed hard on the heels of dear old Captain Cook—was it seventeen hundred and something?—and we've had the true habit of laundering our clothes ever since! We have actually arrived at the point in history of pulling down old dwellings; there, in the humble dust, one may trace the simple outline of its substance, bedrooms, kitchens and, lo, separate laundries. It's bin a long time.

Yours for accuracy,

ENID BELL.

36 Cobran Road, Cheltenham,
Sydney, New South Wales.

## Information by Television

SIR, I find your columnist, Mr. F. H. Smith, one of the brighter stars in the industrial information firmament, although a little facetious at times, but now he has over-reached himself (ENGNG., 18 Mar. '60, p. 394) in his ribaldry on CCTV (let him work that one out) [CCTV—closed circuit television].

The advantages of such a system in the circumstances described are obvious even to the most goggle-eyed watcher of the idiot's lantern. The research worker does not have to travel half a mile to look up an odd reference.

As for page turning, he is obviously oblivious of the mechanical page turners developed in the United States for use by hospital patients, and now undergoing modification for remote control.

London may think of it tomorrow.

Yours sincerely,

T. BRIMELOW.

Cobdown House, Ditton,
Near Maidstone.
22 March, 1960.

## Events in Advance

### Forestry Machinery in Operation

Indications are mounting that the exhibition of forestry machinery being arranged by the Forestry Commission on Wednesday and Thursday, 4 and 5 May, at the Yorkshire Agricultural Society's showground, Harrogate, is likely to be the largest demonstration of its kind so far to be seen in Europe.

It is expected that visitors from overseas will include members of a Food and Agriculture Organization working party on the development of forestry machinery. As at an earlier and similar exhibition held in South East England two years ago, a wide variety of machinery and equipment will be displayed, much of it in operation. There will be included tractors, power saws, timber carriages, vehicle loaders, drain diggers, bark peelers, ploughs, forest nursery machinery, tree planters, winches and saw benches for timber conversion.

Opening hours will be from 10.30 a.m to 5.30 p.m. daily and there will be no charge for admission. Car parking facilities will be provided at a small fee and refreshments will be available on the site. Additional information may be obtained from the secretary, the Forestry Commission, 25 Savile Row, London, W1. Tel. REGent 0221.

## Exhibitions and Conferences

**Plastic Crystals and Rotation in the Solid State, Symposium.**—Tues and Wed., 5 and 6 April, at the Inorganic Chemistry Laboratory, Oxford. Sponsored by the Office of Ordnance Research, United States Army. Details obtainable from Mr. L. A. K. Staveley, Inorganic Chemistry Laboratory, South Parks Road, Oxford.

**X-Ray Analysis Group of the Institute of Physics, Spring Conference.**—Fri. and Sat., 8 and 9 April, at the main chemistry lecture theatre, The University, Reading. Theme: "The Borders of X-Ray Analysis." Information obtainable from Dr. P. T. Davies, "Shell" Research Ltd., Thornton Research Centre, P.O. Box 1, Chester.

**Ship Trials and Service Performance Analysis, Symposium.**—Mon., 11 April to Wed., 13 April, at Newcastle upon Tyne. Organised jointly by the North East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Newcastle upon Tyne 1 (Newcastle 20289), and the Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. Tel. Central 5181.

**Powder Metallurgy: Direct Rolling Processes in, Informal Discussion.**—Tues, 12 April, at Church House, Great Smith Street, London, SW1. Organised by the Powder Metallurgy Joint Group, 17 Belgrave Square, London, SW1. Tel. BELgravia 3291.

**Audio Fair.**—Thurs., 21 April, to Sun., 24 April, at Hotel Russell, Russell Square, London, WC1. Organised by Audio Fairs Ltd., 42 Manchester Square, London, W1. Tel. WELbeck 9111.

**South Eastern Union of Scientific Societies, 65th Annual Congress.**—Fri., 22 April, to Mon., 25 April, at Ipswich. Apply to Mr. Frank Edwards, 53 The Drive, Shoreham-by-Sea, Sussex.

**Institute of Metal Finishing, Annual Spring Conference.**—Tues., 26 April, to Sat., 30 April, at the Grand Hotel, Scarborough. Offices of the Institute: 32 Great Ormond Street, London, WC1.

**"400 kV Network: Future Stage of Regional Interconnection," International Convention.**—Tues., 26 April, in Brussels. Sponsored by the Association des Ingénieurs Electriciens, of the Institut Electrotechnique Montefiore, 31 Rue Saint Gilles, Liége, Belgium.

**Nuclear Reactor Containment Buildings and Pressure Vessels, Symposium.**—Tues., 17 May, to Fri., 20 May, in Glasgow. Organised by the Department of Mechanical, Civil and Chemical Engineering, Royal College of Science and Technology, Glasgow, C1. Tel. Bell 4400.

**Electronic Equipment Reliability, Symposium.**—Wed., 18 May (10.30 a.m., 2.30 p.m. and 5.30 p.m.), at the Institution of Electrical Engineers. Registration by those attending is required. Organised by the Institution of Electrical Engineers, Victoria Embankment, London, WC2. Tel. COVent Garden 1871.

**Space Heating of Industrial and Commercial Premises: Refresher Courses for Works and Plant Engineers.**—Mon., 30 May, to Sat., 4 June, at Prestatyn Holiday Camp. Organised by the National Industrial Fuel Efficiency Service, Baltic House, Mountstuart Square, Cardiff. Tel. Cardiff 33825.

## Meetings and Papers

### Aslib

LONDON
"Standards on a Common Language for Machine Searching and Translation," by Brian C. Vickery. Tues., 5 April, 6 p.m.*

### British Institution of Radio Engineers

LONDON
"Work of the British Standards Institution in Relation to the Radio and Electronics Industry," by H. A. R. Binney. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Thurs., 7 April, 6.30 p.m.*

### British Interplanetary Society

LONDON
"Lunar Missions and Vehicle Design," by J. Allen. Caxton Hall, off Victoria Street, SW1. Thurs., 7 April, 7 p.m.

### Chemical Society

ST. ANDREWS
"Nuclear Resonance," by Dr. R. E. Richards. St. Andrews and Dundee Branch. Chemistry Department, St. Salvators College, St. Andrews. Fri., 8 April, 5.15 p.m.

### Illuminating Engineering Society

NOTTINGHAM
"Trends in Lamp Design, 1884 to 1984," by E. E. Miles. Nottingham Centre. Electricity Centre, Carrington Street, Nottingham. Thurs., 7 April, 6 p.m.

### Institute of Fuel

SHEFFIELD
Annual General Meeting and Open Discussion. Yorkshire Section. Royal Victoria Hotel, Sheffield. Wed., 6 April, 2.30 p.m.

### Institute of Marine Engineers

LIVERPOOL
"Some Crankshaft Failures: Investigations, Causes and Remedies," by R. Atkinson and P. Jackson. Merseyside and North Western Section. Liverpool Engineering Society, 9 The Temple, 24 Dale Street, Liverpool. Mon., 4 April, 6 p.m.

### Institute of Petroleum

LONDON
"Systematic Prediction of Refinery Utilities," by F. P. Alban. Wed., 6 April, 5.30 p.m.*

### Institute of Physics

LONDON
"Nuclear Fuel Element Inspection," by R. S. Sharpe. Non-Destructive Testing Group. Fri., 8 April, 6 p.m.*

### Institute of Refrigeration

LONDON
"Some Problems Associated with the Use of a High-Speed Reciprocating Compressor for Aircraft Cooling Projects," by J. D. Gurney. Joint Meeting with the Low Temperature Group of the Physical Society. Institute of Marine Engineers, 76 Mark Lane, EC3. Thurs., 7 April, 5.30 p.m.*

### Institute of Welding

SLOUGH
"Shop Inspection of Welds." Discussion. Slough Section. Community Centre, Farnham Road, Slough. Tues., 5 April, 7.30 p.m.

### Institution of Chemical Engineers

BIRMINGHAM
"Aspects of Process Economics": various papers, at the morning session. "The Chemical Engineer and His Position in Management": various papers, at the afternoon session. All-day discussion meeting. Midlands Branch. Chemical Engineering Department, The University, Edgbaston, Birmingham 15. Tues., 5 April, 9.30 a.m. to 5.30 p.m.

### Institution of Civil Engineers

LONDON
"Economics of Waste Water Treatment," by C. B. Townend. Tues., 5 April, 5.30 p.m.*

### Institution of Civil Engineers of Ireland

DUBLIN
"Engineering Library Resources," by J. G. Daly. Mon., 4 April, 6.15 p.m.*

### Institution of Electrical Engineers

LONDON
"Very-High-Frequency Sound Broadcasting: Subjective Appraisal of Distortion Due to Multi-Path Propagation in Frequency-Modulated Reception," by R. V. Harvey. Electronics and Communications Section. Mon., 4 April, 5.30 p.m.*
"Thermistors: Their Theory, Manufacture and Application," by Dr. R. W. A. Scarr and R. A. Setterington. Measurement and Control Section. Tues., 5 April, 5.30 p.m.*
"Novel Methods of Speed Control Applied to Standard Three-Phase Squirrel Cage Induction Motor," by G. K. Creighton and W. M. Somerville; "Preset Screwdown Control in Steel Rolling Mills," by R. M. Epps; and "Linear Electrical Machines," by P. J. Lawrenson. Utilization Section and London Graduate and Student Section. Thurs., 7 April, 5.30 p.m.*

BIRMINGHAM
"Generating/Motor Problems in Pumped Storage Installations," by Dr. J. H. Walker. South Midland Centre. College of Technology, Gosta Green, Birmingham. Mon., 4 April, 6.30 p.m.*

### Institution of Engineering Designers

BIRMINGHAM
"Developments in Precision Hollow Forgings," by H. D. Challen; and a film on the same subject. Midlands Branch. Queen's Hotel, Birmingham. Wed., 6 April, 7 p.m.

### Institution of Heating and Ventilating Engineers

LONDON
"Second Edition of the Institution's Guide": Discussion introduced by members of the Guide Committee. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park SW1. Thurs., 7 April, 6 p.m.*

### Institution of Mechanical Engineers

LONDON
"The All Light-Alloy Engine: How Far Off is It?" Discussion to be opened by R. C. Cross. Automobile Division. Wed., 6 April, 6 p.m.*

NOTTINGHAM
"Submersible Pumping Plant," by H. H. Anderson and W. G. Crawford. East Midlands Branch. Portland Building, The University, Nottingham. Tues., 5 April, 6.30 p.m.

### Institution of Plant Engineers

EDINBURGH
"Basic Principles of Lubrication," by G. Soutar. Edinburgh Branch. Heriot-Watt College, Chambers Street, Edinburgh. Tues., 5 April, 7 p.m.

### Liverpool Metallurgical Society

LIVERPOOL
"The Examination of Irradiated Fuel Elements," by G. B. Greenough. Annual General Meeting. Department of Metallurgy, Liverpool University, 146 Brownlow Hill, Liverpool 3. Thurs., 7 April, 7 p.m.

### Newcomen Society

LONDON
"Some Windmill Fallacies," by Rex Wailes. Wed., 6 April, 5.30 p.m.

### Physical Society

LONDON
"Some Problems Associated with the Use of a High-Speed Reciprocating Compressor for Aircraft Cooling Purposes," by J. D. Gurney. Institute of Marine Engineers, 76 Mark Lane, EC3. Thurs., 7 April, 5.30 p.m.*

### Reinforced Concrete Association

BIRMINGHAM
"Precasting in Concrete Framed Construction," by J. F. Greinig and R. C. Westbrook. Midland Counties Branch. Birmingham and Midland Institute, Paradise Street, Birmingham. Tues., 5 April, 6 p.m.*

### Royal Society of Arts

LONDON
"Hovercraft," by C. S. Cockerell. Wed., 6 April, 2.30 p.m.

### Society of Chemical Industry

LONDON
"Presentation of Corrosion Information," by J. W. Jenkin. Spring Lecture. Wed., 6 April, 6 p.m.*

### Society of Engineers

LONDON
"Research Testing," by A. E. Bingham. Geological Society, Burlington House, Piccadilly, W1. Mon., 4 April, 5.30 p.m.*

### Society of Instrument Technology

LONDON
"The Electronic Computer as a Unit in an Automatic Electronic Data Processing System for Missile Trials," by W. C. J. White and D. L. Overheu. Data Processing Section. Manson House, 26 Portland Place, W1. Thurs., 7 April, 7 p.m.*

### West of Scotland Iron and Steel Institute

GLASGOW
"Mill Operation": various short papers by T. Harris, G. Steel and J. Craig. Fri., 8 April, 6.45 p.m.

**The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated.** An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

Aslib (Association of Special Libraries and Information Bureaux), 3 Belgrave Square, London, SW1. (BELgravia 5050)
British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
British Interplanetary Society, 12 Bessborough Gardens, London, SW1. (TATe Gallery 9371)
Chemical Society, Burlington House, Piccadilly, London, W1. (REGent 0675)
Illuminating Engineering Society, 32 Victoria Street, London, SW1. (ABBey 5215)
Institute of Fuel, 18 Devonshire Street, Portland Place, London, W1. (LANgham 7124)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London, EC3. (ROYal 8493)
Institute of Petroleum, 61 New Cavendish Street, London, W1. (LANgham 3583)
Institute of Physics, 47 Belgrave Square, London, SW1. (BELgravia 6111)
Institute of Refrigeration, New Bridge Street House, New Bridge Street, London, EC4. (CENtral 4694)
Institute of Welding, 54 Princes Gate, Exhibition Road, London, SW7. (KNIghtsbridge 8556)
Institution of Chemical Engineers, 16 Belgrave Square, London, SW1 (BELgravia 3647)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Civil Engineers of Ireland, 35 Dawson Street, Dublin.
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Engineering Designers, 38 Portland Place, London, W1. (LANgham 8847)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Liverpool Metallurgical Society, Greenhithe, Grosvenor Road, St. Helens, Lancs. (St. Helens 5879)
Newcomen Society, Science Museum, Exhibition Road, London, SW7. (KENsington 1793)
Physical Society, 1 Lowther Gardens, South Kensington, London, SW7. (KENsington 0048)
Reinforced Concrete Association, 94-98 Petty France, London, SW1. (ABBey 4504)
Royal Society of Arts, John Adam Street, Adelphi, London, WC2. (TRAfalgar 2366)
Society of Chemical Industry, 14 Belgrave Square, London, SW1. (BELgravia 3681)
Society of Engineers, Abbey House, Victoria Street, London, SW1. (ABBey 7244)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)
West of Scotland Iron and Steel Institute, 39 Elmbank Crescent, Glasgow C2. (Central 5181)

# Reliability Tests on Construction Plant

**Facilities are available at the Military Engineering Experimental Establishment for testing civilian construction plant under repeatable test conditions devised in cooperation with the manufacturers' associations.**

The Military Engineering Experimental Establishment is carrying out, at the request of manufacturers and for a charge, tests on civilian construction plant. The tests are standardised and repeatable and conform to test codes prepared by MEXE in cooperation with the Federation of Manufacturers of Construction Equipment (FMCE) in accordance with relevant British Standards.

The primary purpose of MEXE is to provide equipment for the Army, especially the Royal Engineers. To this end the establishment designs and tests purely military prototypes without any obvious civilian use; undertakes the examination of plant on the civil market to prove it and, if need be, amend it for military use (the object is to have military and civilian equipment interchangeable wherever possible); and, thirdly, the straightforward testing of many types of equipment that fall generally into the construction field. The Establishment is now willing to do these tests, for a fixed price, at the request of the maker.

The headquarters of MEXE together with the structures testing facilities, materials laboratories and stores are at Christchurch, near Bournemouth, in Hampshire. A few miles away, at Hurn, the Establishment possesses an open site of 880 acres that is the proving ground for earthmoving equipment.

## SCOPE OF SERVICE

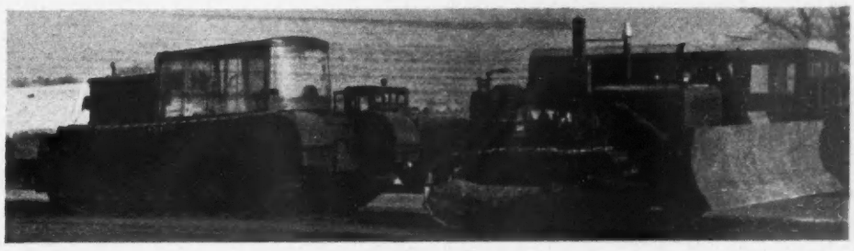
Interest in such equipment, especially earthmoving and road making plant, first really began at the Establishment just after the Second World War and early in the 1950's the manufacturers' association was pressing for a testing ground to be set up. It was not until 1958, however, that spare capacity became available and plans were put in hand to provide a service, for cash, for the manufacturers. The first piece of equipment arrived for testing in August, 1959. There is now a waiting list.

Plant for which the service is designed includes wheeled and tracked tractors, excavators and diggers, graders, stone crushers, gritters, coated macadam plant (mixers as well as laying and finishing machines), cranes and fork lift trucks. A test programme is agreed with the manufacturer in advance, and tests are normally carried out in accordance with a test code that has been established in conjunction with the FMCE. A typical programme might include (*a*) a verification of the manufacturer's specification relating to the machines' dimensions, capacity, horsepower, speeds through the gears, tyres and materials used in its manufacture, together with a description of other items likely to affect a purchasing decision;
(*b*) the normal performance under standard testing conditions in the duty cycle for which the plant is designed;
(*c*) track and dynamometer tests where these are applicable.

During the test, the manufacturer is allowed to correct any defects that may be disclosed and changes can also be made in design or materials that will increase the ease with which his plant can be maintained (MEXE pays especial attention to this point).

Under the agreement that has been devised to cover the relationship between the Establishment and the manufacturer, it is laid down that the manufacturer, or his representative, may be present throughout the test and may have access to all the data recorded. The manufacturer also may nominate the driver or operator to handle the machine during the test. Before beginning the work, the manufacturer is given an estimate, followed by a fixed price figure, for his test programme. After the test MEXE provides 12 copies of the report to the manufacturer. This report includes only the factual results of the test and does not convey any opinions. The manufacturer can print and publish as many copies of the full report as he may wish, but extracts or abridgements of the report may only be published with the consent of the Director of MEXE; in this way the Establishment hope to maintain their position as an independent and authoritative testing body.

*Heavy road making equipment just after a demonstration braking test on one of the standard tracks at MEXE's proving ground at Hurn.*



*The heavy track-mounted dynamometer car which can develop 80,000 lb resistance and is used for checking the drawbar pull of tractors.*

The right is reserved to use any information derived from the tests for British Government purposes. If, however, a manufacturer undertakes not to publish the report himself the report will not be circulated to anyone, including other government departments, without the permission of the manufacturer.

In addition to the above activities, MEXE has also begun an advisory service for prototype testing so that manufacturers can take advantage of the experience of the staff at the Establishment while developing a new machine.

## FACILITIES

The facilities at Hurn includes test tracks, a bogging tank, a test area for roadmaking plant, test slopes of 1 in 3 and 1 in 4, tilting bays and a soils stabilisation area.

On arrival at Hurn any item of plant is subjected to an examination to see that it complies with the published specification in respect of dimensions, capacities (or hoppers), description of the engines or other motors, controls and constructional details. The total weight of the equipment is recorded, including the distribution of weight between the wheels or tracks. To do this a mobile weighing vehicle is used that has four loading jacks, each attached to a recording dial on the vehicle; this vehicle is also used to check the operational weight of equipment undergoing tests.

Speed and braking tests are carried out on one of five tracks laid out side by side across the site. Of the five tracks, four are all-weather surfaces, each designed to enable specific data to be evaluated for each machine. The overall length of the tracks is 440 yd and at each end there is a turning pad of 100 ft diameter. The tracks are level throughout its length. An extension of a further 300 yards is being constructed so that higher speeds can be tested.

The centre track is a dense tar surface, possessing a high coefficient of adhesion when either wet or dry, and is used to determine the " reserve tractive ability " of self-propelled wheeled plant such as tractors, loading shovels, motor graders, lorries of all types and motor scrapers. This track is 26 ft wide and has a subgrade designed to support the heaviest wheel loads without perceptible deformation.

On the immediate right of the centre track is a surface that provides constant non-slip properties under varying conditions of temperature, humidity and saturation. On this track equipment can develop its maximum tractive effort with the minimum of track slip. The composition of the surface, which was developed by MEXE, is clay, stone and sand together making 89 per cent; hydrated lime 2 per cent; and rubberised bitumen 9 per cent. With crawler tractors up to 200 h.p. the track slip rarely exceeds 3 per cent and 7½ per cent slip is the most recorded with even bigger machines. Under the maximum load, developed against the pull of a dynamometer car, the tracks of the vehicle penetrate and tear at the surface, but the surface is easily restored by a few passes of a 6-8 ton steel wheeled roller. This track is 30 ft wide; to the left of the centre track is another of similar non-skid construction, but only 15 ft wide. This track is over five years old and was the first of its kind ever to be built.

## ON SAND AND BOG

On the extreme right of the test tracks is one for evaluating the beach and shore mobility of vehicles. This track is divided into two lengths, one consisting of beach sand and the other having a surface of 2½ to 4 in assorted shingle. Details that can be checked on these surfaces include effectiveness of tyre patterns and inflation pressures. These lanes are ideal for assessing the ability of plant to work on beaches and riversides.

Similar factors of tyre characteristics can also be checked on the other outside track, which is

typical of those normally met on construction sites, having an adhesion of 65 to 75 per cent. The surface is reinstated after test runs by grading, rolling and occasionally adding water. It is, however, like its prototypes on sites, not suited to all-weather operation and after heavy rain testing becomes impracticable as adhesion is considerably reduced.

In contrast to the five tracks just described a boggy terrain course has been laid down so that vehicles can be subjected to mobility tests under measurable states of difficulty. The two boggy conditions most likely to be met and provided on the course are:

(*a*) disturbed road surfaces of boggy soil such as sand, clay or organic material which rest on a firm but sticky bottom, and

(*b*) peat and other organic surfaces that rest on a saturated bottom.

This course becomes progressively harder to negotiate as vehicles advance until aided recovery is required. Conditions are maintained as near constant as possible.

(*Left*) *An overloader on the 1 in 3 slope where it has to demonstrate its ability to brake, reverse and change gear.*

(*Right*) *The tilting platform where the engines have to run to prove that the fuel system will operate for long periods with the vehicle on the cant.*

To examine the capabilities of a machine when working on a slope, MEXE have built two standard slopes of 1 in 3 and 1 in 4 and there is also a tilting pad and a rocking table. The two slopes, and also an easy gradient of 1 in 10, are surfaced with a close texture high-adhesion bitumen which retains almost constant characteristics in either wet or dry conditions. Vehicles are driven both up and down the slopes, laden and unladen, and may also be required to stop, reverse and change gear while on the gradient; static and parking brake tests are also carried out on these slopes. There is also a turning pad marked with concentric turning circles for checking the wheel lock of vehicles.

## WORKING ON A SLOPE

The tilting or stability platform is used to prove the critical angle at which the machine becomes operationally unstable. Several of the test codes specify the angles of tilt at which safe engine running is obligatory. The platform is hydraulically operated and can be tilted about an edge through a measured angle until the machine would overturn if not constrained. Static braking tests can also be checked on this table. All the tests on the platform are repeated with the machine reversed to determine if the machine has a " bad " as well as a " good " side. To ensure that conditions of adhesion remain sensibly constant, two parallel bands of high class bitumen paving are set in the platform top.

All service equipment must have its centre of gravity clearly defined, and a knowledge of the location of the CG of civilian plant is frequently desirable if not essential. At Hurn a tilting table has been built with a fore and aft movement; the machine is shunted backwards and forwards until the point of balance is reached. Machines weighing up to 40 tons can be so examined and repeated measurement shows that the CG is successfully located within 1 in.

Crawler tractors have to be able to negotiate steeper gradients than wheeled vehicles, and for them a grass covered slope of 1 in 2 is available. Machines are tested in forward, backward and crosswise positions with the engines running to prove the adequacy of the lubricating and fuel systems.

Two dynamometer cars are in use, one on a six-wheeled vehicle which develops a drawbar pull up to 30,000 lb, the other on crawler tracks and able to measure pulls up to 80,000 lb—about the limit that can be sustained by any tractor on the track surfaces that are available. The dynamometers, besides providing the controlled drag that simulates the load on the machine, are equipped to measure and record the following data:

(*a*) the maximum draw bar pull and the mean pull for the duration of the test;

(*b*) true progression speed, both indicated and recorded;

(*c*) wheel slip, separate recorders being used for each wheel;

(*d*) engine r.p.m., the revolutions being both counted and recorded; and

(*e*) the true distance covered and, by difference, the slip during the period of the test.

Measurements of displacements are carefully surveyed where *in situ* digging occurs, and quantities are checked by weighing where appropriate.

After the field tests have been completed the machine can be taken back to the Christchurch headquarters where engine tests can be made. A new mechanical and electrical test house is in the process of being finished. It consists of three test cells, each cell containing three beds fitted with universal holding down points. The floor of each cell is a massive 3 ft thick concrete pad, spring supported to have a frequency of 3 cycles per second. Surrounding the cells are comprehensive systems of fuel, cooling water, electric power, recording equipment and exhaust extractor services. Two of the beds are fitted with dynamometers (one of 250 h.p. and the other of 60 h.p.); these dynamometers are coupled to a common control and can only be used one at a time. After the field test, the engines are bench tested, b.h.p. curves obtained, smoke levels located and fuel consumptions measured. The stripped engine is also checked for wear.

*Working capacity of overloaders and similar plant is proved by using them to move stockpiles of carefully graded stone.*

Increasing attention is now being paid to the matter of the operational noise level of both engines and constructional equipment. The test made at the Establishment gives the noise level in decibels at the operator's seat and also at positions 100 ft to the windward and leeward sides of the machine while it is performing at full power.

## MOVING SOILS

Earthmoving plant under test at MEXE perform all their specified displacement functions on a quantity/time basis. Each series of tests is done on soils or materials appropriate to the machine. Considerable supplementary tests have been made to correlate the effects of working and recompacting the spoil and of weathering on the workability of the soils so that all the tests may be standardised and comparable. Dozers, scrapers and graders carry out their tests on sandy loams, clay and sandy clay. (It might be pointed out here that test programmes conducted on coarse granular materials, while not being typical of the working medium of the machine, might be the better basis of a standard test.)

Loading shovels are proved on stockpiles of sand, 1 in screened aggregate, 4 in aggregate, 12 in block stone, and 24 in block stone.

In addition, there is a well equipped materials testing laboratory, radiography and X-ray equipment, a plastics room and a corrosion room, and a new metallurgy laboratory.

Most recent of the construction equipment designed at MEXE is a road surfacer which has a working speed of 15 m.p.h. and carries sufficient grit to lay a strip about 8 ft wide by 700 yards long before re-loading. The bitumen tank contains enough material for three such runs. The vehicle is based on a Scammel lorry fitted with a 200 h.p. Rolls-Royce engine. Independent heaters keep the bitumen fluid in the tank and through the pipes leading to the spray which has a variable discharge. The grit is laid off a reverse travelling platform so that it has zero speed relative to the ground; this ensures that the grit is uniformly deposited and not thrown outside the intended path.

The MEXE test service for civilian construction plant is now in full operation, though subject to the demands of the Services. Manufacturers who want to know more about the test procedure should address their inquiries to the Director, MEXE, Christchurch, Hampshire, asking for a copy of " Notes on Testing Civil Engineering Construction Plant."

# Human Element

## Highway Scholarship offered Overseas

A bursary covering a full academic year at the Birmingham University graduate school in highway and traffic engineering is this year being offered to overseas engineers by the Federation of Manufacturers of Construction Equipment.

The graduate school's course is for nine months and would be followed by three months private work, some of it in his home country, on critical reports on the laboratory work engaged in by the engineer.

The FMCE offer is open to engineers from any Commonwealth country, the Argentine or Iran. They must hold a recognised engineering degree, be employed by a municipal authority or a national department of transport, be able to speak English well and write it and also undertake to return to and follow their profession in their home country for at least two years.

The bursary will be worth about £550 each year and will include living expenses and the cost of travel in Britain but not to this country.

Nine months at the graduate school seems hardly long enough for the syllabus, which covers—traffic analysis and computation; highway economics, planning and geometric design; highway materials, construction methods and plant; statistics and design of experiments, photogrammetry and air survey.

Applications should reach the FMCE offices in Queen Victoria Street, London, EC4, before 6 June this year.

## GCE Children Up in Arms

Pride in the school was one of the worthy qualities it was hoped would gradually grow up in the secondary modern schools set up after the 1944 Education Act.

It is now an established fact in some schools of that description. Not surprisingly it is expressed by its young devotees in some unexpected ways.

At Kidlington, in Oxfordshire, form 4A reacted strongly when the education authority announced that it was postponing for a year the setting up of fifth and sixth year G.C.E. courses at the Gosford Hill secondary modern school. Form 4A met, discussed the decision of the authority and then the head girl and seven 14 and 15-year-old prefects went on strike. Later in the day seven boys joined the disaffected band.

The reason for the authority's decision is the Ministry of Education's restriction on the number of teachers that can be employed by the county for the year. The effect of this at Gosford Hill is that those who intend to stay at school and go through with their GCE course will have to go ten miles away to another school.

The action of the fourth formers shows spirit and more concern for their work than is often credited to the young. The education authority appears, in sending its decision to their parents and not making a statement to the pupils, to be out of touch with the people in its classrooms.

## Is a Satisfied Worker More Efficient?

It is a measure of the success achieved by the National Institute of Industrial Psychology in taking the blinkers off opinion that the automatic assumption —of course a contented operative is more efficient—would now find less unqualified support than in earlier years.

The Institute's annual report lists a number of important research projects on which work is going ahead, mainly still on the shaping of the technique to be used.

The questions to which the Institute hopes to find the answers are: how far a worker's satisfaction with his job affects his efficiency, how people in industry view their opportunities and rewards, to what extent managers feel that their jobs allow them to make full use of their ability and to make the best contribution to the effectiveness of the firm, and the ways in which people differ in manual dexterity.

On the job satisfaction inquiry 8,500 workers in eleven factories have been sent questionnaires and the average return is 57 per cent. NIIP interviews both with those who replied and some who did not should produce some useful information on the value of questionnaires.

Since the 8,500 workers were employed in so few factories it appears that the results may be limited to satisfaction-and-efficiency in the larger works.

In trying to get to know more about personal attitudes to a number of possible goals in life; worldly success, security, creative expression and originality, personal contentment, contribution to society at large, and so on, the Intitutes is to ask, by questionnaire, what personal qualities people would like to possess, given the choice.

It would be pleasant to know what chance people think they have of acquiring the qualities they admire.

The big event of the NIIP year was the renewal of the grant in aid of the fundamental research programme. Since 1956 NIIP has been in relationship with the Department of Scientific and Industrial Research on the same basis as an industrial research association.

## Challenge

The DSIR has agreed to renew the grant for another five years on terms which are at once a promise of greater aid and a challenge to bring more in from industry. The new grant will be for a yearly minimum of £6,000 (previously £4,000) and the maximum is increased to £12,000 (£8,000). The DSIR grant is matched with the contributions from industry and from individuals and the minimum to be found by the Institute is now £9,000, which is £1,000 more than its former maximum.

The new maximum is £12,000 and Lord Piercy, the president, has appealed to firms to support the NIIP in reaching this figure.

A second worry that besets the administrators of the Institute is the recruitment of staff. Some work has been delayed because of difficulties in recruiting staff of enough experience.

## Refugee Apprenticeships

The splendid work done by the Ockenden Venture in bringing refugee children to Britain is to have a follow through into industrial apprenticeships.

A hostel is to be opened near Birmingham to provide for boys, who, having grown up in Ockenden homes, are now on the threshold of their careers.

After completion of their school terms in Birmingham it is expected that the boys will go into local apprenticeships.

## Commonwealth Technical Training Week

The advisory committee for the Commonwealth Technical Training Week has held its first meeting. Its chairman is Sir Frederick Handley Page, the aircraft pioneer, and other members include Lord Morrison of Lambeth, Mr. Robert Willis, former chairman of the Trades Union Congress, and Lord McCorquodale.

The week will be held in Britain from Monday, 29 May, to Sunday, 4 June, 1961, and there will be close but slightly differing dates in the Commonwealth.

## A Standing Committee for Engineers' Salaries?

The comparative figures for professional earnings by the members of ten leading professions in Great Britain, published by the Royal Commission on Doctors' and Dentists' Remuneration, show how disastrously wide is the gulf between theory and practice in the attitude of the community towards the engineering profession.

These are the words of the Engineers' Guild and the Guild statement goes on to point out that the number of engineers needed in the United Kingdom is increasing and is likely to go on increasing for at least the next ten years.

" The supply (of engineers) has never yet been sufficient to meet the demand and is not expected to do so in the immediate future. In these circumstances it would be natural to expect the engineering profession to be respected and its members well rewarded for their services; instead the figures show that not only is it poorly remunerated but that it stands in public esteem, if levels of payment constitute any guide, among the most humble of the professions today."

The Guild draws the conclusion that this is a state of affairs which must affect the quality as well as the quantity of new entrants into the profession. It then says: " early consideration by the Government of the economic problems confronting members of the engineering profession is essential."

While it may be essential that engineers' rewards should rise it is wishful thinking to bring the Government into it. Engineers are not a well defined group like university teachers whose needs the Government were able to recognise and to a large degree meet. They have a wide variety of employers, both public and private. Their organisations are concerned with qualification and practice and not with pay.

Expecting the Government to raise engineers' pay is to disregard the way in which the profession is employed.

The Guild is on much stronger ground when it acclaims the Royal Commission's proposal of a standing committee to review future pay of doctors and dentists as a constructive suggestion towards the determination of professional salaries.

" The proposal," says the Guild, " avoids the serious disadvantages which are inevitably created for professional people by collective bargaining machinery and it may well be capable of extension to other fields of employment in which such machinery at present operates.

" The Guild welcomes the proposal and will be glad to cooperate in any consideration which may be given to its wider application."

## The 42 hour Week and Fewer Tea Breaks

Will the 42 hour week, which came into effect on the first day of this week, have the paradoxical effect of intensifying the shortage of labour now felt by some engineering industries?

This possibility is brought about by the widespread manner in which the pace of work in plants is set by the machines and not by their operatives. In these circumstances the only way to get more out of the same production lines is to work them for longer periods.

This is one reason why the engineering employers expect the shorter working week merely to put up overtime costs, rather than to increase leisure time. But there is another way.

For some time there has been pressure for three shift working. As a method of maximum production at lower labour cost per unit, because of the elimination of overtime, it has many attractions. Precisely for that reason it is less of a cheering prospect to workers already dependent on overtime.

The greatest difficulty is that it is exactly in the West Midlands, the area most busy and most in need of men, that three shift plants would find it hardest to recruit the necessary new labour.

Not unexpectedly, some unreasonable demands are being made locally as managements meet trade union representatives to apply February's agreements. In more than one plant the men have asked for the 42 hour week to be introduced by the ending of an existing Friday four hour night shift and the alteration of the present four nine and a half hour shifts to four of ten and half hours.

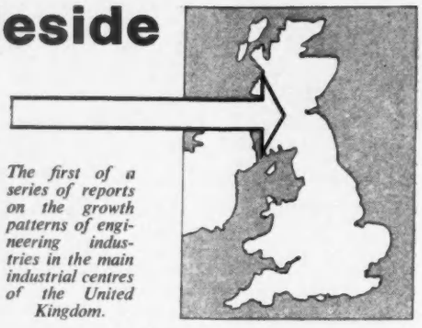
The arrival of the shorter working week may be one of those moments of change which make possible radical improvements that were otherwise impossible. Some months ago inquiries in Midland firms as to whether automatic vending machines were being used for a continuous provision of tea and snacks and so the removal of the tea-break produced replies varying from " They wouldn't stand for it " to " They would strike if we mentioned it."

Now it seems the atmosphere has become one of change and while the shop stewards are no less quick to react there is a very good chance that Music While You Work will become widely supplemented with (theoretically) unlimited quantities of tea and coffee while work goes on uninterrupted.

# Engineering Growth on Clydeside

**Light and precision engineering are helping to offset the decline in Scottish heavy engineering. The influx of American and other firms is proving to be a wonderful tonic.**

*By H. J. Novy*



*The first of a series of reports on the growth patterns of engineering industries in the main industrial centres of the United Kingdom.*

Ironically, one of the major contributions of Clydeside industry is likely to be the ten thousand or more of its working people who will emigrate each year, many of them apprenticed to a craft or with a higher education. This human export, and a parallel and even more impressive export of capital, have since the First World War provided the United Kingdom and the English-speaking world overseas with much of the best produced by Scotland's industrial pre-eminence in the mad growth years of the iron ship and the steam engine in the 19th century.

The definitions of the problem of Clyde industry which follow are given as they were stated by eminent Scotsmen. They are followed by a brief analysis of the facts as I saw them during my visit and talks. No apology is given for the historical treatment. Without digging fairly deeply into the area's industrial roots it is difficult to understand developments and even harder to project them into the future.

In many quarters I found an emotional attitude to Scotland's industrial and sociological problems which make objective assessment difficult. Some see industry on Clydeside as a fine mechanism which only needs a strong push for all to be well. One likened it to a motorcar with a faulty self-starter, another to a pump the self-priming mechanism of which had failed. To both, industrial activity could be stimulated from without and in this manner the area resume a net growth. The opinions we quote are those of a university professor, Dr. A. K. Cairncross, who is a recognised authority on the social and economic problems of Scotland; of a trade union leader who has spent a lifetime among the workers of heavy industry; and of an industrialist who has founded an electrical engineering company now leading in its own field in the United Kingdom.

## POINTERS FROM THE PAST

Professor Cairncross comments as follows on the developments of the past 50 years. Having pointed out that the Glasgow economy and the economy of Scotland are inextricably linked, he suggests that " anyone looking back in Glasgow's history is bound to feel a sense of diminution from former glories." The textile industry, which first brought factories to Glasgow and from which much of the manufacturing of the area descends, has almost disappeared. The coal mines of Lanarkshire, long the source of the cheapest and best coal in Scotland and comparable with the best in Britain, have declined steadily for half a century and are increasingly uneconomic to work. The iron industry which once supplied the bulk of the world's import of pig iron became in time the prime example of the backwardness of the heavy industries and, although now in the course of rejuvenation, has still to struggle with competitive handicaps such as high fuel costs. The steel industry, after its efforts in the last two decades of the 19th century to keep pace with the growing requirements of the local shipbuilding industry, has remained tied to the fortunes of that industry and supplies a much diminished proportion of British output. In shipbuilding itself, although the industry has never enjoyed such consistent pressure of demand, over the past twenty years, output has expanded little and the Clyde's share of world output has fallen in the past ten years from 15 per cent to 5 per cent.

He underlines the fact that Glasgow's population, which was over a million in 1911, has not risen significantly since. " The conurbation as a whole has grown by a smaller increment in the past fifty years than was normal in succeeding decades towards the end of the 19th century." The absence of growth in Glasgow is apparent to the naked eye in the absence of new buildings in the square mile that contains the commercial centre of the town. The town is well planned but its appearance is drab and uncheerful.

When the key industries for which Glasgow and the Clyde valley had special advantages, which were essentially the heavy industries, lost their momentum the industries which grew up to meet the needs of the area during its period of rapid expansion proved incapable of maintaining this momentum. The complex of inter-related industries became upset when steam power, which was pioneered on the Clyde for ship, rail and industrial prime movers, began to be displaced by oil and electricity. " The old momentum perished," said Professor Cairncross, " and other areas with a different range of facilities and skills proved more attractive as locations for the newer industries."

## MORE NEW INDUSTRY

Clyde industry has all the disadvantages of history: habits have crystallised into what was appropriate and led to success 50 years ago. Management methods, workers' skills and workers' organisations also have crystallised in the same way. There is an urgent need to bring more new industry to the Clyde, but no extravagant hopes should be built upon this process. There is room for an expansion in chemicals. More light engineering, particularly electrical and electromechanical, could usefully be introduced. There is no particular reason why such an influx should not take place but neither is there any compelling reason why it should. The Scots will be lucky, argues Professor Cairncross, if the number of jobs is maintained. The solution of the unemployment problem must therefore involve continued emigration from the Clyde.

The views of Mr. J. C. Lang, who is president of the Scottish Board for Industry and a long-standing trade unionist, are from a very different standpoint but differ only in emphasis. He considers that Clydeside is over dependent upon heavy industry and that this industry is unfavourably placed for further expansion.

Shipbuilding is more likely to contract than to expand over the next decade, coal will almost certainly continue to contract and the prospects of iron and steel are far too tied to shipbuilding, constructional engineering and the production of heavy industrial plant to offer real hope of expansion. Mr. Lang points out that the 100,000 or so new jobs created since the war are not enough to offset the wastage in existing jobs, and shares Dr. Cairncross's view that the area has in fact been saved from acute distress by emigration.

He has no criticism of the area's spread of industry, which is as diverse as that of the United Kingdom as a whole, but points out that the usual industrial classification hides the real facts of the situation, namely, the inclusion of contracting industries under general headings. The decision to build a major steel strip mill at Colville's is to Mr. Lang the first and only major favourable factor in a possible industrial rebirth. The development of commercial vehicle plants in the area by British Motor Corporation and Rootes are the first evidence of " industry following the mill," and more must follow, particularly if the Government are prepared to adopt a firm policy concerning the grant of Industrial Development Certificates now that the new Bill on local unemployment becomes an Act of Parliament.

The general quality of management, particularly in the heavy industries, the failure to invest in modernisation, the prospects of a shrinkage in shipbuilding activity—these were cited by Mr. Lang as unfavourable factors in the general industrial situation of Clydeside. Basically—and this is where he differs from Dr. Cairncross—Mr. Lang considers that the relative decline of Clydeside industry can and must be arrested by Government measures. The large sums of native capital continually flowing out of the area should be invested in it, the Board of Trade must be ready to spend large sums of money in inducing light industry to come to the Clyde, and the products to be made there should be of a high value per pound so that the incidence of transport costs is low.

Mr. Lang is a strong supporter of " priming the pump "; his main complaint is that the priming is too little and too late.

The industrialist I talked to is a first generation owner-manager who started his own firm because he was denied what he considered reasonable advancement when working in the steel industry. His firm is one of the most successful light engineering concerns to be started between the wars.

He considers that there are three major contributing factors to the industrial decline of Clydeside, relative to other UK areas. The first is the general quality of management. When the First World War came industry was managed by the second or third generation of the founder families, most of them having few managerial skills and almost all sadly lacking in training. Management decay set in and brought in its train a disrespect and indiscipline, in fact a vote of no-confidence, on the part of the managed.

## SUPPLY OF GRADUATES

This is despite the fact that Scotland's universities, and her general system of education, produces a first rate supply of graduates and technically trained men. An inquiry in 1955 showed that 395 manufacturing firms employing 89,000 workers in the Glasgow area employed no more than 469 graduates, of whom 83 were graduates in arts, 124 in science and 204 in engineering. In the shipbuilding industry, thirteen firms employing 21,000 operatives included only 18 graduates on their staff. In few sections of industry can there exist so marked an absence of educated men, in a country where educated men abound.

The second factor the industrialist mentioned was the lack of capital for local investment. For this he blamed the Scottish banking system and the policy of native investment trusts. Only in recent months has there been a change in this sterile situation with the creation of a unit trust, Scotshares, under the chairmanship of Lord Polwarth. The success of the issue—£½ million was asked for and £5½ million offered—suggests that the Scottish investment trust managers will follow in Lord Polwarth's path and that more local money will become available to back local industry in the future.

Lord Polwarth, who is chairman of the Scottish Council (Development and Industry),

recently wrote of investment in Scotland in the following terms: "It provides greater opportunities for consumer goods industries and for industries in the rapidly growing fields of electrical engineering, chemicals, metallurgy, precision engineering," adding a statement of his faith that "Scotland bids fair to enlarging her share of the industries of the future and establishing herself securely in the forefront of the world's industrial nations."

## DIVERSIFIED

The pattern of Clydeside industry emerges from the statistics of insured workers, whether in employment or not, given in the Table. This indicates both the importance of major industrial groups in the area, relative to each other and to the total employment in the same group for the United Kingdom as a whole. The general picture which emerges is one of considerable diversity: in fact Clydeside has an economy more diversified than any other part of the kingdom.

It is useful in this context to quote Professor Cairncross on the subject of the industrial pattern of Glasgow, since his comments apply to that of Clydeside, only with greater force: "Although Glasgow had a far more diversified economy than is commonly appreciated, the environment was not congenial to the newer industries: the existing complex exercised a gravitational pull on industries that could easily be integrated into it, but it repelled other industries that could not, and that flourished only if allowed to dominate and mould the economy in which they took root. The replacement of one industrial structure by another is never easy and always prolonged, most of all when deflation is slowing down the whole process of industrial change. It takes time for new growth to occur: for new firms to force their way to the front, new capacity to be created, new types of skill to be acquired. If the current has set strongly in one direction, it is hard to prepare another channel. Employment may be found at first for a few hundreds in unfamiliar pursuits; but to turn the hundreds into thousands and multiply the thousands takes years of effort and enterprise by a host of firms sustained by confidence that they can succeed, by the prospect of an expanding market and by their power to compete in it."

The industrial groups which are more strongly represented on Clydeside than in the UK as a whole are, in the main, metal manufacture and the very broad "engineering, shipbuilding and electrical goods"—to use the Board of Trade's classification. Within these, however, which together account for over one fifth of total employment in this area and for 43 per cent of employment in manufacturing industry, there is a preponderance of heavy industry. Where considerable scope exists for industrial expansion is in chemicals, vehicles and metal goods (particularly those utilising light castings, forgings, steel sheet and tinplate).

Although the economy of Scotland, and that of Clydeside in particular, was greatly weakened during the inter-war period by the violent setback to the key industries, the pattern was already beginning to change.

The war and post-war years have seen a marked acceleration of the process of transformation. To this, the industrial estates, beginning with Hillington in 1937, have contributed greatly. There are now 21 industrial estates and some 40 factories on individual sites together employing some 65,000 workers, mainly in light industry. In an introduction to "Pathway to Prosperity," published by Scottish Industrial Estates Limited on the occasion of their 21st anniversary in 1958, Sir David Eccles, then President of the Board of Trade, wrote: "The Government provided the money, Scottish Industrial Estates the know-how, and from this contribution sprang new factories, new industries, new employment for Scotland."

There is no doubt that industrial estates have provided a basis for the introduction of new industries and the type of soil in which new industries could hope to flourish. The largest employers of labour, Rolls-Royce, came to Hillington in 1938 and currently employ some 10,000 people spread over several locations. During the war they employed 25,000 at Hillington alone.

The attraction of Scotland as a location for American firms began a long time ago, in fact in the last century when the North British Rubber Company was established in Edinburgh from the shipment of a complete American factory, in 1856. Singer sewing machine company established themselves at Clydeside only a few years later.

## PRECISION ENGINEERING

The influx, particularly since the war, has been a wonderful tonic to Clydeside. Scottish Industrial Estates have 21 tenants of North American origin, many of whom have programmes of rapid expansion. The settlement and expansion of the office machinery industry, which includes IBM in Greenock, Olivetti in Glasgow, Remington Rand at Hillington, Burroughs on the Vale of Leven estate, and at Cumbernauld, and National Cash Register at Dundee, is one of the more hopeful post-war developments. Production of clocks by S. Smith & Sons (England) Limited, near Wishaw, by Westclox at Vale of Leven, and by Timex near Dundee, is yet further evidence that precision engineering can flourish on Scottish soil.

The other major growth during the post-war era has been that of the earth-moving equipment industry. Four companies of US origin—Euclid, Caterpillar Tractor, Hyster and Cummins Engine Co. Ltd.—have established themselves, thus forming an important nucleus which includes the production of auxiliary equipment such as winches and power units. The managing director of Euclid (Great Britain) Limited, Mr. P. K. Hoglund, forecast that within the next decade the earth-moving equipment industry in Scotland could employ 75,000 people and its exports exceed in value those of whisky and knitwear. To a major extent it will be up to the management of these companies to create a climate of employment in which the crystallisation of attitudes—the restrictive practices, the demarcation jealousies and other characteristics inherited from a hard past—will dissolve gradually and leave these workers free to use their unusual skills to promote the interests of the new industries.

## PROXIMITY TO MARKETS

During my talks on Clydeside I put many questions to locally established industrialists the suitability of Clydeside as a location.

In most cases their main markets lie in the other great industrialised areas of the country, primarily London, Birmingham and Manchester. The answers varied in the emphasis placed on transport costs or convenience, the accessibility of head offices, the proximity of customers, the difficulties of attracting key personnel and particularly young graduates. No-one with experience of manufacturing in the area took the view that the location's remoteness from large markets or centres of research was in itself a major handicap. Rather that the requirement was good organisation, the use of the more efficient methods of transport and effective communications at all levels. The handicap most frequently mentioned related to the unpopularity of the location for executives who originate or have been educated in other areas.

A number of firms who have selected Scotland as a location in recent years make the kind of product which requires close and constant contact with users because they supply application engineering and depend on users for technical progress. Among these, Jas. Scott & Co., who were originally electrical contractors, manufacture the All Scott range of electronic apparatus in Glasgow. The Ferranti and Remington Rand factories are even further afield. Progress in transport techniques, the use of helicopters and company aircraft for executives, of fast night freight trains which enable loads to be collected at the end of the working day anywhere on Clydeside and delivered anywhere in London at the start of the next day, new roads (a widened and improved A 74), a tunnel under the Clyde—not to speak of a Forth road bridge and a Tay bridge—will help to make the problem of remoteness relatively unimportant, as it appears now to most American firms.

The Scottish Council have done remarkable work in finding products which can be made under licence by Scottish firms, and their industrial committee's secretary, Mr. H. M. Wilson, can draw on his experience as an industrial consultant to help him in advising firms on long-term industrial policy.

The Scottish Council have also sponsored a new study of the Scottish economy under the chairmanship of Mr. J. N. Toothill, the managing director of Ferranti's Edinburgh plant. Clydeside has much to offer, in resources, amenities, traditions and skills.

Eventually our island will fill to capacity, and this will include Clydeside. Meanwhile progress will continue to be made but regress may leave a negative balance. Textiles, iron, shale oil, coal have come and are slowly going. Other contractions must begin in the next decade but it may well be that vehicle manufacture will fill out the gap, together with the earthmoving machinery, business machines, electronics and other industries the new strip mill is bound to attract.

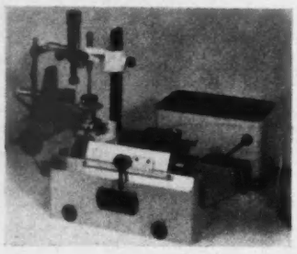
*Clyde Valley* District of Scotland—Number of Insured Employees in Industries and Services*

| Main Industry Groups | Number (thousands) | | | Percentage of Total | Percentage of United Kingdom | United Kingdom Total |
|---|---|---|---|---|---|---|
| | Male | Female | Total | | | |
| 1 Agriculture, forestry and fishing | 5 | 2 | 7 | 0·7 | 1·0 | 677,940 |
| 2 Mining and quarrying | 18 | 1 | 19 | 2·0 | 2·2 | 865,550 |
| 3 Non-metalliferous mining products | 11 | 1 | 12 | 1·3 | 3·7 | 334,130 |
| 4 Chemicals, etc. | 15 | 6 | 20 | 2·1 | 3·8 | 544,110 |
| 5 Metal manufacture | 41 | 3 | 44 | 4·3 | 7·6 | 577,550 |
| 6 Engineering, shipbuilding and electrical goods | 139 | 24 | 163 | 16·8 | 7·4 | 2,206,550 |
| 7 Vehicles | 39 | 6 | 44 | 4·5 | 3·6 | 1,235,150 |
| 8 Metal goods | 15 | 5 | 20 | 2·0 | 3·8 | 516,900 |
| 9 Precision instruments, etc. | 4 | 3 | 8 | 0·8 | 5·0 | 151,440 |
| 10 Textiles | 16 | 28 | 45 | 4·6 | 4·7 | 952,150 |
| 11 Leather, etc. | 2 | 1 | 3 | 0·3 | 4·8 | 65,170 |
| 12 Clothing | 6 | 23 | 28 | 2·9 | 4·4 | 647,660 |
| 13 Food, drink and tobacco | 25 | 25 | 49 | 5·0 | 5·3 | 938,310 |
| 14 Wood and cork | 9 | 3 | 12 | 1·2 | 4·1 | 292,870 |
| 15 Paper and printing | 13 | 10 | 23 | 2·4 | 4·0 | 586,780 |
| 16 Other manufacturing industries | 5 | 2 | 7 | 0·7 | 2·4 | 291,940 |
| 3-16 *Total Manufacturing* | 340 | 139 | 479 | 49·2 | 5·1 | 9,340,710 |
| 17 Building, etc. | 66 | 4 | 70 | 7·2 | 4·9 | 1,428,550 |
| 18 Gas, electricity and water | 13 | 2 | 14 | 1·5 | 3·7 | 386,970 |
| 19 Transport and communications | 61 | 14 | 75 | 7·8 | 4·4 | 1,715,510 |
| 20 Distributive | 52 | 71 | 123 | 12·6 | 4·8 | 2,547,450 |
| 21 Insurance, banking, finance | 9 | 7 | 16 | 1·7 | 3·2 | 509,250 |
| 22 Public administration and defence | 21 | 11 | 32 | 3·3 | 2·3 | 1,355,420 |
| 23 Professional services, etc. | 26 | 54 | 80 | 8·2 | 4·4 | 1,824,070 |
| 24 Miscellaneous services | 15 | 35 | 50 | 5·0 | 3·1 | 1,626,820 |
| XS (Unclassified) | 1 | 1 | 1 | 0·1 | 5·3 | 11,760 |
| *Grand Total* | 627 | 341 | 967 | 100·0 | 4·3 | 22,290,000 |

* Glasgow, North Lanarkshire, Dumbartonshire, Renfrewshire and North Ayrshire. Source: Ministry of Labour Statistics.

## INVOLUTE TESTER

### For Small Gears



Now available is the No. 1 involute tester for checking deviations in the profiles of the teeth of small gears.

The instrument is designed for use in conjunction with the No. 1 rolling gear tester, to which it is attached. Tooth profiles can be measured on gears up to 4 in diameter and with diametral pitches from 20 to 100. The standard rolling gear tester saddle centres take up to 6 in in length.

In order to set the stylus accurately on fine teeth the operation is viewed through a microscope. Special composite stylus points are used and there is a two speed drive from a standard Goulder power drive unit. The gear is secured to the base circle disc by a lock nut and the base circle incorporates an arbor for locating the gear in the correct position. A lapped steel straight edge bears against the base circle to generate the true involute form. In addition to the power operation the movement can be carried out by a hand wheel mounted at the side. There is an adjustment screw for setting the zero initially. Gear mounts are available for both standard and non-standard sizes.

The composite stylus incorporates a spring steel feeler, and the measuring pressure has a biassing control. Stylus movements can be recorded on a chart using a Taylor-Hobson amplifier and recorder with a choice of magnifications of 100, 200, 500, 1,000, 2,000, or 5,000. Alternatively, a Magna-Gage and pen recorder can be used giving magnifications of 400 and 4,000. The instrument can be supplied alone or complete with the rolling gear tester on a metal cabinet. *J. Goulder and Sons Limited, Kirkheaton, Huddersfield.*

## TRACTOR SHOVEL

### 1½ Cu. Yd Capacity

A new hydraulically operated tractor shovel is the Allis-Chalmers HD6G which has a bucket capacity of 1½ cu. yd.

Power is supplied by a 79·5 h.p. diesel engine giving the tractor a drawbar pull of 16,670 lb. Four forward speeds from 1·5 to 5·5 m.p.h., and two reverse speeds of 2·0 and 4·1 m.p.h. can be selected by one lever.

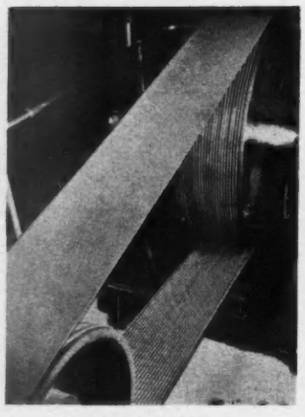
The dumping height of the tractor is over 9 ft and the reach is 3 ft 9½ in at a height of 8 ft. The curved bottom bucket tips back 40° at ground level. and has a breakout force of 21,500 lb at the cutting edge. Shovel functions are controlled by the hydraulic system, the pump for which is mounted on the front end of the engine crankshaft. All controls are said to be within natural reach of the driver. A decelerator pedal and a bucket level indicator are included. Excellent all-round visibility is claimed.

A new sand deflecting fan has been fitted to improve the life of the fan itself and of the radiator core. It is driven from a double sheave on the timing gear shaft and the belts are easy to replace. The hydraulic lines have re-usable fittings.

A wide variety of attachments is available; rear-mounted equipment includes a ripper and a back hoe. Front-mounted attachments include a rock bucket, rock fork, light materials bucket, lift tongs and lift forks, crane hook, and straight and angled dozers. These are mounted quickly by simply knocking out and replacing four pins. Standard fittings include 13 in semi-grouser shoes, full width guards and 24-volt starting and lighting equipment. *Mackay Industrial Equipment Limited, Central Way, Feltham, Middlesex.*

## DRIVE BELTS

### High Power Transmission



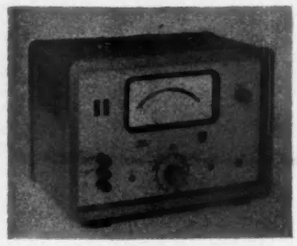
Now to be made in this country is the Poly-V belting which is claimed to incorporate the best of both flat and V belt drives.

The chief feature is that the belting consists of a flat belt with a large number of parallel longitudinal ribs moulded on the underside. These ribs form the mating surface and completely fill corresponding grooves on the pulleys. This arrangement allows the load carrying member to extend across the full face of the drive without the breaks of the multiple V belts, and secondly the inner face has about twice the area in contact as compared with a multiple belt drive of comparable width. It is claimed that Poly-V belts increase drive capacity by about 50 per cent.

The material is made soft at the ribs to spread into the grooves (which are much shallower than with V belts) and has a strength member of synthetic cords across the back. This is covered with a layer of harder material. Belts are made in three sizes to cover the present complete range of V belts. Another great advantage is that there is no matching up to form sets as is the case with separate belts. Tensioning pulleys can be used on the back of the belt without damage, though they are not always needed. *Turner Brothers Asbestos Company Limited, Rochdale.*

## MILLIVOLTMETER

### Automatic Polarity Switch



A new Philips d.c. millivoltmeter type G6020 has voltage ranges from 100 μV to 1,000V and a choice of 22 current ranges.

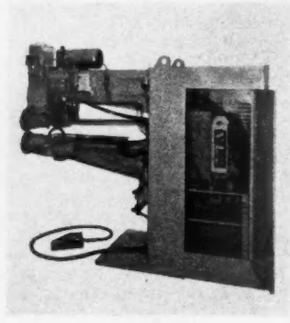
The instrument covers full scale deflections from 100 μV to 10V in eleven steps with an input impedance of 1 megohm and from 10 mV to 1,000V also in eleven steps with an impedance of 100 megohms. Current ranges are from 100 μμA to 10 μA full scale. The accuracy is 5 per cent of full scale in the 100 μV range and 3 per cent in all others.

There is automatic switching to suit the polarity of the voltage or current to be measured, and this is indicated by means of two luminous colours. There is also full protection against overloads. Any standard mains supply of frequency from 40 to 100 c/s can be used. Calibration is carried out by an internal voltage and the 5 in linear scale has an anti-parallax mirror. The input resistance is high and remains constant, while the input capacitance is low.

With a measuring probe, VHF voltages from 0·1 to 800 Mc/s may be measured in the 1 mV to 16V range and resistances up to several megohms can be accurately measured with the aid of an external voltage. Because of its high sensitivity, the G6020 can be used for many purposes in the electronics industry, in medical, biological, geophysical, metallurgical, and chemical research, and for measurements carried out with thermoelectric elements and strain gauges. The construction is sturdy and as a rule the instrument can be used as a galvanometer. *Research and Control Instruments Limited, Instrument House, 207 King's Cross Road, London, WC1.*

## ROLL SEAM WELDER

### Air Operated



The Sagu 125 now being made in this country is an air-operated universal roll seam welder for sheet metal sections.

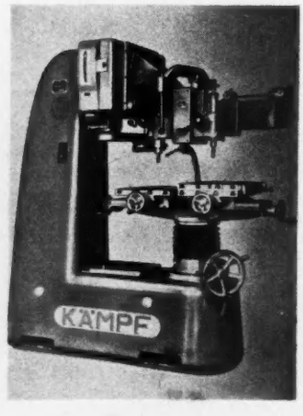
A main feature is the mounting of the motor for the upper electrode on the top of the upper arm, the drive being transmitted by a vertical shaft and gearing through the air cylinder and the welding head to the electrode. This eliminates long drive shafts. The machine can be adjusted for circumferential or longitudinal welding by rotating the upper head through 90° in either direction and changing the lower arm extension.

The motor is a Kopp variable speed unit developing 0·5 h.p. at 1,000 r.p.m. A reversing switch allows circumferential welds to be made clockwise or anti-clockwise as required. The motor speed can be set between 310 and 2,800 r.p.m. which, in conjunction with five wheels from 7 in to 9 in diameter, gives a range of linear speed from 22·8 in per min to 258 in per min.

An air cylinder on the upper arm allows a maximum force of 1,625 lb between the electrodes for an air pressure of 70 lb per sq. in. Welding is initiated by a two-stage foot switch that first causes the upper arm to descend and then switches on the welding current. The stacked core water cooled transformer with an eight step tap link panel gives a range of outputs from 55 kVA for a 100 per cent duty cycle to 160 kVA for a 12 per cent cycle. *Electro-Mechan Heat Limited, Lower Teddington Road, Hampton Wick, Kingston-on-Thames, Surrey.*

## DIE SINKER

### Three Dimensional Shapes




Now available in this country is the Kämpf FK1 die sinking and copy milling machine.

The machine is designed to have a capacity large enough for most small and medium die work and to be priced within the range of the small tool shop. A mechanical copying system is used with a full size master. It is claimed that reproduction is accurate to within ± 0·001 in.

The arrangement of the cutter and stylus heads allows an area of 10 in by 8 in to be covered in a single setting of the machine and the work piece. Longitudinal and transverse screw movements of the table increase the area to 14 in by 12 in. The maximum distance between the table and the lower end of the milling spindle is 14 in. Work pieces of any length can be handled as the sides are clear. An auxiliary table can be mounted on either the milling or the pattern table.

The setting elements are all arranged at one side and stylus movements are controlled by the joystick and the cross movements by the handwheel. An infinitely variable speed drive covers the range from 700 to 10,000 r.p.m. The drive is taken from a 1 h.p. two-speed motor through V belts. *Embassy Machine and Tool Company Limited, 248 Watford Way, Hendon, London, NW4.*

## CAPACITANCE BRIDGE

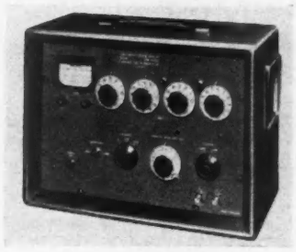
### Down to 0·002 $\mu\mu$ F

A NEW low capacitance bridge, Marconi type TF1342, will measure capacitances in the range from 1,111 $\mu\mu$ F to 0·002 $\mu\mu$ F.

Values between these two figures can be determined to an accuracy of 0·2 per cent. Measurements are made between any two terminals of a three-terminal network and are virtually unaffected by the impedance between either of these terminals and the third point. This allows long leads to be used to connect the component under test, and so *in situ* checking without disconnection of associated circuits. This is particularly valuable where it is important to include inherent shunt and stray capacitances which cannot be "disconnected" for conventional measurement.

The resistive and reactive components of the unknown capacitor are separately balanced out in a transformer ratio-arm bridge, the unknown and standard impedances being connected on opposite sides of the bridge.

Decade switching and read-out are



provided, with automatic decimal point indication. Effective shunt resistance of the component under test is balanced by a standard resistor fed through three switched transformer tappings and a continuously variable potentiometer. The total range is from 1 megohm to at least 1,000 megohms.

The bridge is complete with internal 1,000 c/s oscillator and detector. The detector gain can be switched to provide high or low sensitivity, and to facilitate balancing automatic gain control is used to give a progressive increase in sensitivity as the balance point is approached. *Marconi Instruments Limited, St. Albans, Hertfordshire.*

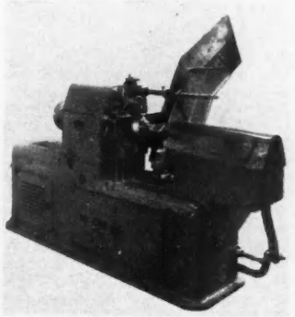
## TRIMMER AND CURLER

### Hollow Ware Stampings

TWO new fully automatic machines are now being made for trimming and curling the edges of hollow-ware stampings.

The operator feeds the stampings or spinnings to the chute from which they are picked up by the feed plate, carried to the chuck and clamped. Cam controlled trimming cutters remove the irregular and excess material from the flange, and it falls away down a separate chute. The remaining even width of flange is curled by a single roll that is brought into contact automatically. Trimming or curling can either be carried out separately if desired. The trimming cutters are mounted above the chuck and the roll below.

The chuck and the clamp are both driven, but the trimming cutters and the roll run free. All adjustments are easily accessible. Model UT will take stampings with a maximum flange diameter before trimming of 14 in and after trimming of 13 in. The minimum diameter after trimming is 4 in and the



maximum depth of stamping is also 4 in. Maximum thickness is 0·03 in. Output can be varied from 20 to 28 per minute.

The TT machine is smaller taking only up to 7½ in diameter before trimming, and 6½ in after. Maximum thickness is 0·025 in and the output is 30 per minute. Both machines are arranged for quick change of tools to suit a change in stamping size. *Moon Brothers Limited, Beaufort Road, Birkenhead.*

## LAMP HOUSING

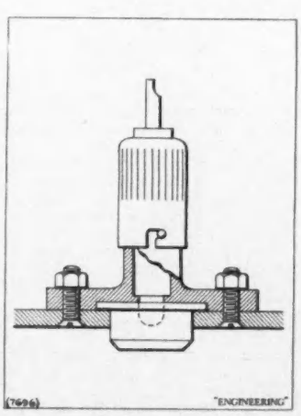
### Miniature Indicators

THE lamp housing illustrated, type EMLH, is designed for miniature indicator lights for panel mounted displays.

It is particularly made for those applications where it is desirable for the lamp cover or lamp to be reached only from the back of the panel, preventing perhaps unauthorised changes from the front.

The housing has a nickel plated body which is bolted to the back of the panel, of a size to accommodate an Atlas miniature lamp type 995-9118. There are versions of this lamp for 28V, 12V, 6V and 1·5V supplies, all being rated at 1 watt.

The terminal is made of gold-over-silver-plated brass and has a solder cup for ease of connection. The cap is approximately ½ in outside diameter and like the body is made of nickel plated brass. The fitting is by bayonet action. The lamp cover which projects through the panel about ½ in and is approximately 0·6 in diameter, is of moulded




translucent polyethylene and is available in four colours—red, green, yellow, amber, as well as natural tone. Two types of fixing are made; one with two 6BA holes set 1 in apart and the other with three holes set on a 1 in pitch diameter circle. *Electro Methods Limited, Hitchin Street, Biggleswade, Bedfordshire.*

## COLD HEADER

### Double Blow Action

THE range of cold heading machines made by Peltzer and Ehlers has been extended by the addition of six machines intended to handle material from $\frac{1}{16}$ in to $\frac{1}{4}$ in diameter.

The machine illustrated is the DKP/S6 for producing bolts or similar components with a maximum shank diameter of $\frac{1}{4}$ in and up to 1 in long. Output is up to 200 pieces per minute. The machine is driven by a 7·5 h.p. motor through a variable speed unit to cover the range from 320 to 1,425 r.p.m. Multiple V belts transmit the power to the flywheel which is equipped with a foot brake.

Material is fed from a coil to the adjustable rollers of the straightening device by power driven rolls with a quick release. The blank is cut off and fed to the heading position where the punch first presses it into the die before exerting the full force of the blow. Simultaneously the whole or part of the shank can be extruded to the diameter required. During the next revolution of the crank-

shaft the finishing punch moves into position and completes the heading operation by a single blow. The blank is ejected and falls down a chute assisted by a jet of air.

A pressure lubrication system delivers oil to all positions on the machine. Surplus oil is caught on a tray on the base. The position of the punch block carrying the preforming and finishing punches is easily and quickly adjusted, and resetting the machine for a different diameter of wire takes a very short time. An inching button is included on the electrical controls. *Rockweil Machine Tool Company Limited, Welsh Harp, Edgware Road, London, NW2.*

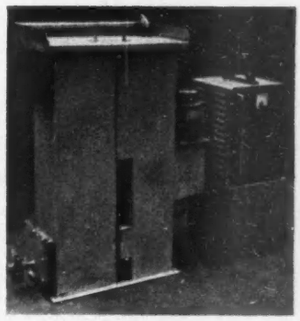
## DEGREASING PLANT

### With Ultrasonic Cleaning

THERE is now being made a series of ultrasonic cleaning plants designed for use with trichloroethylene.

The smallest of these plants is the ULV1 which has a compartment size of 9 in by 7 in by 7 in deep. Ultrasonic generating equipment made by Dawes is connected to a sealed stainless steel transducer unit containing barium titanate elements submerged in cold trichloroethylene in one compartment of the plant. Here the electrical impulses at a frequency of 40 kc/s are changed to mechanical vibrations which cause cavitation in the solvent. The solvent in the cleaning compartment is circulated by a pump through a filter and back to the same compartment. The filter element can be easily renewed.

The second compartment holds electrically heated boiling trichloroethylene below a vapour layer. Vapour rises to the condensing coils and falls as liquid to the ultrasonic compartment, returning to the vapour compartment by running over a weir. A cooling coil in the ultra-



sonic compartment prevents the temperature rising above 60° C and damaging the transducer.

Heavily greased articles pass first through the boiling liquid then to the ultrasonic section, and finally through the vapour. Items not so contaminated pass direct to the ultrasonic chamber. Larger plants have three chambers to give a continuous flow of work. *Imperial Chemical Industries Limited, Millbank, London, SW1.*

## PRINTING MACHINE

### Offset Litho

THE Faxi offset litho printing machine is compact in size and reasonable in price.

It is designed to take a range of paper sizes from 4½ in × 5½ in to 14 in × 19½ in and in qualities from thin bank to six card sheet. Particular claims are made for the roller cleaner which consists of a squeegee trough clipped into the position normally occupied by the damping rollers. Blanket wash is used to wet the ink rollers and the machine is then switched on making the rollers revolve and clean themselves at the same time.

The machine is finished in cream and chromium and is powered by a 1 h.p. motor. The output is from 1,000 to 5,400 impressions per hour.

The standard range of accessories supplied includes a set of half-width rollers for foolscap plate, two full width split rollers for use with two foolscap plates and an additional pyramid or rollers for inking heavy solids. There is also a complete set of small offset chemicals,

a set of tools for all maintenance work and 50 alloy litho plates. *General Trade Equipment Limited, 82-90 Seymour Place, London, W1.*

# Electrical Engineers Exhibition

*Earl's Court, London 5 to 9 April*

"Marine Electrics" is the main theme of this year's Electrical Engineers Exhibition. Electricity in ships grew slowly and for long was limited to direct current systems. Only 70 years ago, any naval rating switching on or off a light had to report to the Officer of the Watch so that the voltage of the series parallel system could be adjusted to suit. Now the electrical loading is such that one light makes little difference—and anyway the voltage is automatically controlled.

Perhaps the greatest change has been the introduction of alternating current systems, very largely a post-war development. The most recent installation is that of the HMS Hermes, the carrier that was launched last November. Examples of the type of apparatus installed in her will be on show and so will the types of equipment being installed in the SS Canberra, including navigational aids and communication items. A section of 5,000 sq. ft will be devoted to marine electrics, and many exhibits on the individual stands will have a nautical flavour.

Marine items are not alone, however, for there will be the world's largest electrically heated carpet and underlay (it measures 120 ft long by 9 ft wide and is rated at 12·4 kW) and an enormous electrolier hanging from the ceiling; it measures 75 ft in circumference and uses 18·5 kW. There is also an 85 ton locomotive. Some of the items to be seen are described here.

## FUSE SWITCH

### Up to 600 A Capacity

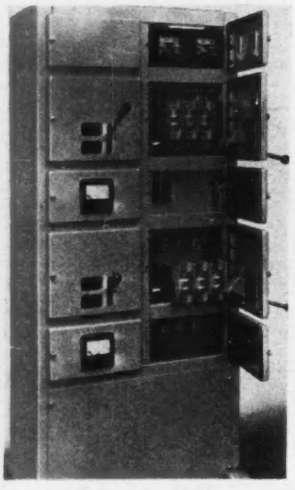
A RANGE of fuse switchgear for currents up to 600A is now available.

The gear complies with BS3185:1959 and is modern in styling. It is fully interlocked. The sizes range from 100 to 600A for current rating and they may be three pole or three pole and neutral link types. Any make of HRC fuse can be fitted.

Switches up to 300A are interchangeable as are sizes from 400 to 600A. The mechanism is common to all sizes and is designed to give a quick make and quick break action. A switch will close fully on a fault regardless of the speed of operation of the handle. It will not blow open under fault conditions.

The contacts are silver plated copper and the finger design is identical throughout the range, the only variant being the number. The busbars are in three sizes: 800A, 1200A and 1400A.

The switches are mounted in a double tier two way or four way chamber. A cast iron door housing the operating handle is fitted over each switch. Doors



to carry instruments are also provided. *George Ellison Limited, Perry Barr, Birmingham 22B.*

## FLUORESCENT FITTINGS

### Acrylic Diffusers

A NEW range of commercial fluorescent lighting fittings is built round two basic units.

There are two models, one ovoid and one trapezoidal in shape but both available for single or twin, 4 ft or 5 ft, with 40 or 80 W lamps. They can be either ceiling or pendant mounted. The second type can have either stepped end plates or enclosing covers while the first has enclosing covers only. All end plates and covers are made in metal and there is a choice of colours—white, red, yellow, or gold. Sparkle holes are offered if desired.

The ribbed acrylic plastic diffusers are designed to slip into position on the channel and are easily removed. They are secured by the end plates which, in turn, are held in place by captive nuts. The corresponding screw is fixed in the securing strap of the lampholder plate. The diffuser is sprung from one side of the channel to allow relamping, cleaning, and maintenance. *Benjamin Electric Limited, Brantwood Road, London, N17.*

## MARINE BATTERY

### Gauntlet Construction

NEW construction of Exide-Ironclad batteries shows a saving in both weight and space making them more suitable for marine applications.

A multitubular "gauntlet" of resin impregnated Terylene cloth is slipped over the spines of the CB59 alloy of the positive plate and holds the active material in a firm elastic grip. The gauntlet enables the electrolyte to penetrate freely to the active material and reduces the shedding of the material to a negligible amount. The bottom of the positive plate is a polyethylene moulding to seal the tubes.

The negative plates are armoured with sleeves of Porvic which eliminates the possibility of internal short circuit. The containers are moulded from toughened hard rubber to obviate leaks and damage from shocks or rough treatment. A saving in weight of 25 per cent is claimed and of 20 per cent in floor area and volume. *Chloride Batteries Limited, Exide Works, Clifton Junction, Manchester.*

## WELDING ALTERNATOR

### Medium Frequency

THE welding alternator illustrated runs at a frequency of 427 cycles and has an output of 250 A.

The alternator consists of a stationary wound armature with rotating permanent magnetic field thus eliminating the use of slip rings and brush gear. The output current is adjustable by means of a link and ten position switch, the range being from 30 to 250 A. By using a frequency of 427 cycles a steep voltage/current characteristic is obtained without the use of a cumbersome control resistance. This elevated frequency also permits the use of a low open circuit voltage for striking the arc and shows welds of deeper penetration than those made at 50 cycles with a similar current setting.

The alternator weighs 100 lb and is of the ventilated type, arranged for foot or flange mounting, and for close coupling to either a motor or engine drive. An additional feature is a specifically designed chassis for attachment to a tractor with belt drive from the power take-off. The unit is claimed to be

trouble free and to need the minimum of maintenance. *Small Electric Motors Limited, Eagle Works, Churchfields Road, Beckenham, Kent.*

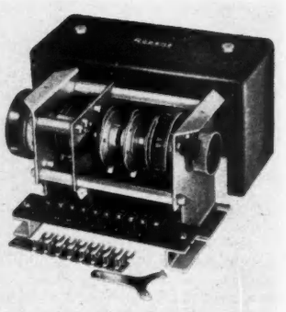
## CAM TIMER

### Three Camshaft Actions

THREE new series of cam timers have been introduced, all of which can have three types of camshaft action.

"Varicams" are improved versions of existing Rodene timers and have quick set cams which can be set by the tool shown. The drum is calibrated every 2° and a fixed pointer allows even closer setting than this. The main bearings are fully floating and are made long to avoid timing inaccuracies due to wear; they are oil impregnated and the housings are spring loaded to allow them to tilt.

"Minicams" are smaller simpler units with either quick set or fixed cams but without setting dial. "Magnacams" are larger versions with additional features. The cams can be set more accurately than for the Varicams and shorter minimum "on" times are possible. There are two drum dials for each switch, one of which is for setting the operate point and the other the release point. The switches are individually removable. Air valves can be fitted in place of the switches.



The three camshaft actions that are available for all three types of timer are continuous rotation for as long as the motor is energised; rotation limited to less than 360° with self clutching motor and return spring, with resetting on switching off; and the same but with a separate clutch that allows stopping and starting without resetting, and very rapid reset. *D. Robinson and Company Limited, 717 London Road, Hounslow, Middlesex.*

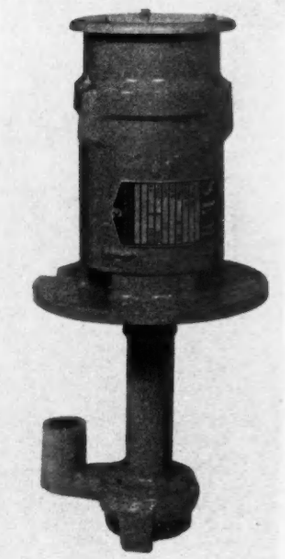
## COOLANT PUMP

### Submersible Type

CHIEF claims for a new coolant pump are that it is light in weight and small in size.

The motor body and pump are an integral unit made in high grade cast iron; the impeller is in aluminium-bronze. The pump intake is shrouded to prevent the ingress of swarf. The motor is continuously rated, totally enclosed and designed to prevent any entry of coolant. The impregnation is suitable for tropical operation.

Normal supply voltages are 220/250 or 380/440 V three phase, 50 cycles, but special voltages are available to order. The pump is of the centrifugal submersible type and can be arranged for either clamp mounting around the pump stem or by the flange. The output varies with the head and viscosity; for example with 30 second Redwood oil the output is approximately 3 gallons per minute at a head of 6 ft. The overall height is 13½ in. *Small Electric Motors Limited, Eagle Works, Churchfields Road, Beckenham, Kent.*



# Neutron Heartbreak

Pulsed neutron sources are increasingly recognised as versatile tools of fundamental and applied research and education. Pulsed sources are becoming standard tools for nuclear cross-section measurements and spectrometry; determination of buckling and fine structure of flux in specific reactor configurations; and can be used as aids in the teaching of neutron and reactor physics at university undergraduate or graduate level.

### Critical and Subcritical Teaching Tools

Of the three main teaching tools in neutron physics —the research reactor, the subcritical assembly, and the pulsed subcritical assembly—each offers certain specific advantages. The research reactor is of course the real thing—a working reactor—and students receive their training under the most realistic conditions. Such realism leaves little margin for inexperience. It costs in the order of £50,000, plus the cost of enriched fuel, but can be employed for a variety of purposes. It can produce radioactive isotopes for use in other departments of the university, and a certain amount of irradiation testing can also be performed. But the very versatility may result in some undesirable interference from the various experimental projects. A subcritical assembly is considerably cheaper and can often be constructed on the university premises to a home-made design. The experiments are limited to steady state flux measurements, but the physical conditions are variable, particularly the arrangement of the fuel lattice and the absorbers. A subcritical assembly requires a powerful source of neutrons involving a large radioactive source which is active whether the experiment is being used or not. The radioactive source may be replaced by a particle accelerator, which, in conjunction with a suitable target, can serve as a neutrons source that can be switched on and off as required. But it is not the safety aspect alone that commends the accelerator as a neutron source. The ability to perform transient experiments by injecting short pulses of neutrons into the subcritical assembly greatly extend the usefulness of the equipment. The cost of such equipment is in the range of £10,000 to £15,000 without the fuel elements needed to form a lattice. Anywhere from two to five tonnes of natural uranium may be required, with a value of about £17,000 per tonne. A pulsed subcritical assembly is in no way a substitute for a research and training reactor; it is rather a versatile tool for experiments in reactor physics which universities with modest means have a reasonable hope of buying.

### Royal Naval College Pulsed Neutron Experiment

With one nuclear submarine on the ways and a second likely to follow, the Royal Naval College at Greenwich is making preparations to have the trained staff available for a nuclear navy. A post graduate course and nuclear research at the College will be centred on a pulsed subcritical assembly supplied by Miles Hivolt and developed jointly by Birmingham University and the Department of Scientific and Industrial Research. An earlier version was described in Atomic Review on 30 Jan. '59. Fig. 1 shows the layout of the equipment consisting of a 150 kV ion accelerator and a light-water moderated natural-uranium subcritical lattice with suitable moderator tanks which permit reflected and unreflected experiments to be performed.

### Features of Pulsed Subcritical Assembly

The accelerator ion source is capable of giving a maximum beam current between 0·75 and 1·0 milliamperes either with hydrogen or with deuterium ions. The subcritical assembly consists of a horizontal array of natural-uranium rods clad in aluminium and supported by two vertical lattice plates. The standard lattice is designed for a square pitch of 1·9 in with an accuracy better than 0·005 in over the entire plate. The assembly is supported in a space frame at a variable height. One of two moderator tanks can be winched into position around the fuel lattice, one giving essentially zero reflection, the other 6 to 8 in of water reflector. The beam tube of the accelerator can be inserted into the lattice through one of four positions, and the target placed anywhere along the tube. A traversing mechanism is provided at the top of the space frame for flux scanning. The necessary services are a power source capable of delivering approximately 8 kVA, and a 20 litre per minute cooling-water supply. The accelerator can be operated continuously or with a pulse repetition rate between 0·65 and 3 kc/s giving a neutron output between $10^8$ and $10^{10}$ neutrons per second. The subcritical assembly can also be operated with a standard radioactive source mounted in a graphite slab. The slab can be fitted under the moderator tank.

### Neutron Spectrometry

By removing the subcritical assembly, the pulsed neutron source can be converted for use in neutron spectrometry. As the probability of most neutron reactions is energy dependent, it is important in all cross-section measurements to determine accurately the energy of neutrons involved in the reaction. Ideally, only neutrons of a single energy would be used, but owing to their electrical neutrality it is not possible to separate a stream of neutrons by magnetic or electric means into suitable narrow energy bands. Neutron choppers can perform the task, working with a high-flux reactor as neutron source, and prior to 1955 were used almost exclusively. The chief drawback of mechanical choppers (or shutters) is that only a single experiment can be conducted with each apparatus, and, since the neutron source is a reactor, the neutrons are accompanied by large bursts of gamma rays. But if the neutrons are obtained from a suitable pulsed target, these will be scattered in all directions and several experiments can be built along radial lines with the target at the centre. Fig. 2 shows the layout of the Harwell neutron experiment using a 25 to 35 MeV linear accelerator. A further advantage of pulsed-neutron sources over choppers arises from the compactness of the target. Only a very small proportion of neutrons emanating from the experimental face of a high-flux reactor is incident upon the slit in the neutron chopper, but the experimental beam tubes surrounding a pulsed target can " see " the whole target surface and utilise all neutrons emanating in the direction of the tube.

### Time-of-Flight

Even with pulsed neutron sources it is difficult to separate neutrons of various energies. The time-of-flight technique is used (Fig. 2) based on the ability of a target pulsed by an accelerator to deliver very short bursts of neutrons in the order of a microsecond duration. The neutrons are directed into evacuated beam tubes and the material the cross-section of which is to be measured is placed at the far end of the tube. The beam tube acts as a race-track in which neutrons of various energies or speeds become separated in space by the time they arrive at the end of the tube. The counting equipment is then arranged to operate for a short period only at the time when the neutrons of the right energy arrive at the " finish-line." Timing and statistical accuracy are in conflict in this experiment. To narrow the energy band of the neutrons which are timed, it is desirable to have as long a beam tube as possible, anywhere from 25 to 100 metres. But the beam intensity is greatly reduced as a result of losses along the flight-path, and the statistical accuracy of counting suffers with the longer tubes. The aim is to increase the intensity of the original beam as much as possible.

### Booster Target

Two techniques are available for improving the beam intensity of a pulsed neutron source. Often the particle output of the accelerator can be increased, or a so-called " booster " target can be used. In the

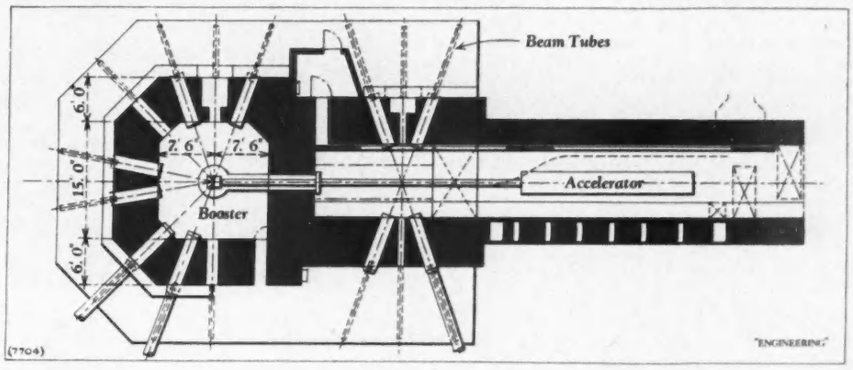



*Fig. 2 (above) Layout of the Harwell neutron experiment with booster target.*

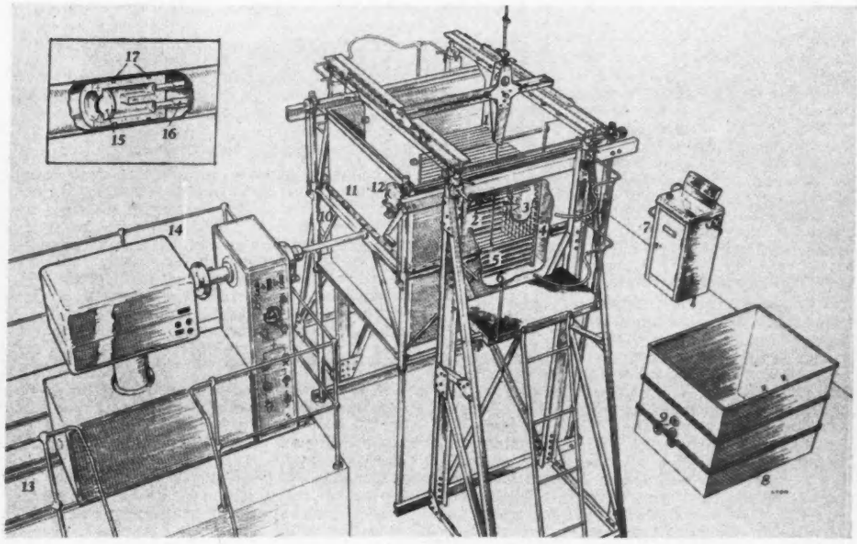



*Fig. 1 (below) Pulsed neutron experiment of the Royal Naval College, using a light-water moderated natural-uranium lattice.*

1 Probe locator
2 Target
3 Alternative target holes
4 Lattice plate
5 Probe
6 Fuel rods
7 Water purifier
8 Small tank (unreflected)
9 Alternative target holes
10 Tank cradle
11 Large tank (reflected)
12 Tank winch
13 Alignment rails
14 Particle accelerator
15 Target
16 Cooling water pipes
17 Sealing rings

Harwell machine an electron accelerator is used, and the beam falls on a mercury target where X-rays are produced and some of the beam energy is dissipated as heat. The X-rays are then directed on a target of uranium 235, which is arranged as a subcritical assembly. First generation neutrons produced by photofission give rise to a second generation of neutrons in the assembly, giving a tenfold amplification to the neutron beam.

The neutron energies of primary concern to reactor physics are in the range between thermal and 50 keV. The table below shows the velocities corresponding to various energies in this range, with the times required for the neutrons to traverse a 50 metre beam tube.

| Energy, eV | Velocity, m per sec | Time of flight, millisec, over 50 m |
|---|---|---|
| 0·0253 | 2,200 | 22·7 |
| 5·0 | 31,000 | 1·53 |
| 50·0 | $10^6$ | 0·5 |
| 5,000 | $10^6$ | 0·05 |
| 500,000 | $10^7$ | 0·005 |

## Notes and News

### Where to Find It

It was erroneously stated in Table I, "Availability of Atomic Energy Research Reports," Atomic Review, 18 March, 1960, that the Public Library, South Sherwood Street, Nottingham, have received no American or Canadian research reports. In fact, the Nottingham library has been a depository of these countries since January, 1958.

### Shielding Chambers from Standard Sets

Instead of designing lead shielding chambers and then specifying each component necessary for their construction, laboratories will now be able to buy standard packages of components. Chambers with minimum internal dimensions of 26 in square by 24 in high and containing two sphere units for remote handling and a standard lead window frame can be built from the contents of the package. By adding standard bricks to the assembly, the chamber dimensions can be extended, and Associated Lead, suppliers of the packages, will ship the required components to make up larger chamber sizes. The packages come in three series differing in the design of the lead bricks. All have 2 in thick walls, with type A and B using precision-machined solid wrought bricks, while type C bricks are extruded. Type A uses chevron mating surfaces, type B curved, and type C serrated mating surfaces. Units of dimensional increase are 8 in width and 4 in in height and depth for types A and B chambers, while the dimensions of type C chambers can be altered in units of 1 in in every direction.

### Uranium Monocarbide: Half Ceramic, Half Metal

Uranium monocarbide could conceivably supersede uranium alloys and uranium dioxide as a reactor fuel material. R. F. Dickerson and Frank A. Rough of Battelle Memorial Instititute report that uranium monocarbide, on the basis of limited data, has many points in its favour as a fuel material for the future. Intensified interest at this time is not due to any sudden or dramatic discoveries concerning uranium monocarbide, rather it is because scientists now have extensive information on metal and uranium dioxide as fuel materials. Certain shortcomings inherent in each of these fuels have led scientists to seek a more complete appraisal of uranium monocarbide.

### High Melting Point and Density

Comparing uranium monocarbide with metal and uranium dioxide as fuel materials, the Battelle scientists made the following observations. Uranium monocarbide possesses heat conductivity that is almost identical with that of unalloyed uranium at low temperatures and about two-thirds that of uranium at temperatures in the 700° C range. With a melting point of about 2,315° C, it has the advantage of being able to withstand roughly twice the amount of heat that uranium can take. Uranium monocarbide's melting point is only 400° C below that of uranium dioxide. For equivalent amounts of material, there is substantially more uranium fuel in uranium monocarbide than there is in uranium dioxide. This is an important consideration in the design of compact nuclear reactors. While there are still serious gaps in information needed to evaluate uranium monocarbide's ability to withstand radiation damage, there is reason to believe that it will be as serviceable under operating conditions as is uranium dioxide. Research now in progress at Battelle should do much to clear up this point. Uranium monocarbide can be processed into fuel elements by several methods. The fact that casting is a low-cost fabrication technique and uranium monocarbide can be cast speaks well for the material, which behaves in some ways like a metal and in other ways like a nonmetallic substance.

### Low Corrosion Resistance

While uranium monocarbide is a leading candidate for the high-temperature reactor of the future, the material has some obvious limitations. It has no resistance to corrosion by water, so it will not be suitable as a fuel for water-cooled reactors unless some means is found to improve its corrosion resistance. Moreover, powders of uranium monocarbide are highly flammable and must be handled in a special atmosphere during fabrication. Finally, there is the possibility that other handling problems might develop in the chemical reprocessing of spent fuel.

### Martin Builds a Meccano Reactor

Built of prefabricated and standardised components, the US Army's PM-1 reactor was designed for air transport to remote sites, and speedy erection during the short construction seasons of northern bases. The 1 MW(e) power plant, once accepted by the army, will be used to power and heat remote radar installations, although the first prototype will be located at Sundance, Wyoming. PM-1, which stands for portable medium-power reactor, consists of three packages shown in Fig. C. The reactor is in the centre tank, submerged in a shield of water,

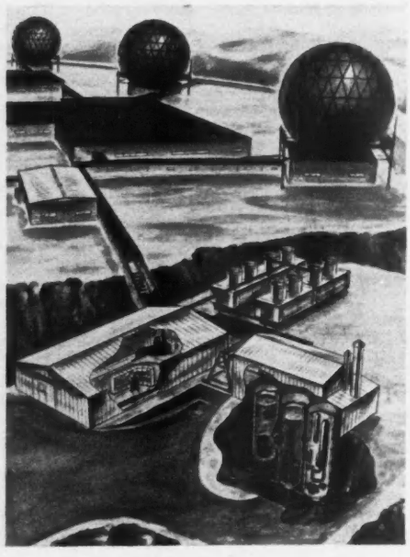


*Fig. 3 Northern radar post with packaged nuclear generating plant sunk into the permafrost. The plant provides both power and heat, and uses air-cooled steam condensers.*

while the heat exchangers are in the right-hand and fuel storage in the left-hand containers. Tubular fuel elements containing a cermet of uranium will be used and a burnup of over 40 per cent is expected on the basis of experiments conducted with the Idaho materials-testing reactor. A most unconventional "conventional" generating plant will be used, employing direct air-cooled condensers shown in the background, and a single turbine with oversize generator instead of multiple units. With a fuel load sufficient for two years of operation, the reactor can make a northern outpost or research station virtually independent of fuel supply lines.

### Reactor Consultants for Brazil

An agreement has been signed appointing Kennedy and Donkin as consultants to the Brazilian Atomic Energy Commission for a projected 200 MW nuclear power station to be built on the coast between Rio de Janeiro and Sao Paulo. A company to handle this project is being set up with a 51 per cent Brazilian Government holding. Minister O. Dias Carneiro, secretary to the Commission, visited the consultant firm here last February. Three considerations favour the choice of a natural-uranium gas-cooled reactor. First, the Brazilian authorities do not expect to receive a grant from the International Bank, so it will be unnecessary to invite tenders from any country wishing to participate. Second, Brazil has substantial uranium deposits and will wish to use these in preference to imported enriched fuel. There are also thorium deposits, which may lead later to enriched-fuel blanket-type reactors, but such reactors are in an early stage of development. And third, they have selected a British firm of consultants.

### Northampton Course in Nuclear Plant Design

A short course intended to give a general survey of sciences related to nuclear power plant design will be given by Northampton College of Advanced Technology from 2 to 13 May. The course is intended to fill in painlessly the background necessary for specialists whose work crosses the path of nuclear power. Graduate status with elementary knowledge of nuclear and reactor physics are entry requirements, along with fee of 20 guineas covering tuition, daily lunch and refreshments, and a trip to Bradwell.

### Electrostatic Precipitation Wire Performance

The usefulness of electrostatic precipitator machines using a moving wire to monitor the fission product contents of reactor coolants lies in the ability to separate the fission-product activity from the background activity induced in the reactor coolant. Two conditions limit the application of the electrostatic precipitators. The coolant activity must fall to the stable state in a single radioactive transition, while the fission-product activity must decay in two or more steps. These limitations are inherent in the operation of the moving-wire machine. A strong electric field is used to accelerate charged particles, and hence particles undergoing radioactive decay, towards a negatively charged wire on which they tend to precipitate. The wire is then moved into a counting device and the radioactive decay is recorded. At least two steps of radioactive decay are needed to get any recording at all, and in order to eliminate interference from induced coolant activity, it is essential that once deposited, the coalant particles should not undergo further decay. Precipitation efficiency is dependent principally on the electric field strength and field configuration surrounding the wire. Precipitation efficiencies of about 80 per cent are obtained in chambers with strong electric fields having a diameter equal to about half their axial lengths. In conjunction with a Geiger-Müller tube through which the wire can pass, an overall counting and precipitation efficiency of between 7½ and 15 per cent results with a precipitator chamber of good performance. The performance of precipitation chambers can be theoretically predicted from fission-product data with an agreement of ±10 per cent with experimental results. (P. Barr and L. G. Ralfe: "The Prediction of the Performance of an Electrostatic Precipitation Wire Machine Using Fission Product Data," AERE Report M593, HMSO, 2*s* 6*d*)

### Abrading Plutonium in Vacuum

Oxidation of plutonium metal occurred when filing was carried out by hand, even under carbon tetrachloride. In the apparatus described, plutonium powder is formed by grinding specimens in a vacuum enclosure, the grinding wheel being a mild steel disc with a piece of file stuck on it with "Araldite." A series of reversals of the wheel produces a flow of filings that drops into the capillary tube. The apparatus has to be opened to glove-box atmosphere for the removal, with a magnet, of any iron particles in the powder, before it is finally sealed. (AERE M/M 227, *The Preparation of Debye-Schere X-Ray Powder Specimens in Evacuated Silicon Capillaries*, R. O. A. Hall, 2 pages, 1 figure, 1*s* 2*d*.)

### Reliability of Nuclear Ship Reactors

As a result of mass production of single reactor types for submarine propulsion, the US Navy is so confident in the design that during sea trials, one reactor was brought to full power five hours after the trials were begun, and all nuclear submarine reactors have so far been successfully brought to full power during the first day of the trials. This information was revealed by John A. McCone, chairman of the USAEC, at a meeting of the American Rocket Society.

### Reactor Notes

*High Flux in Russia:* A research reactor giving a maximum neutron flux of $5 \times 10^{15}$ at a heat output of 100 MW is under construction in the USSR, and will be used to produce multiple-capture transuranic elements.

*Flexibility for Euratom:* A new "flexible" plan for reactor construction under US-Euratom collaboration is now offered to firms who were reluctant to participate in the first round of proposals.

# CAREERS WITH

## KELLOGG INTERNATIONAL CORPORATION

**As a result of an even greater demand for our services in petroleum and petrochemical engineering we invite applications for the following positions:—**

## INSTRUMENT ENGINEERS

Candidates must have University Degree with four years experience, or H.N.C. with six years experience, which should be, preferably, in refinery process instrumentation. Operating experience would be an advantage. Duties of the successful applicants will cover the preparation of process control diagrams, instrument specifications and data sheets, and the selection and location of instruments.

## PROCESS PIPING SYSTEM ENGINEERS

Chemical or Mechanical Engineers are required for work on the design of process and utility piping systems for oil refinery and petrochemical plants. The work involves the preparation of engineering flow diagrams and close liaison with our Process, Instrument, Mechanical Equipment, Plant Layout and Operating Groups. Applicants should have a University Degree in either Chemical or Mechanical Engineering plus at least two years relevant post-graduate experience in industry.

## OFFSITE ENGINEERS

Graduate Mechanical or Chemical Engineers, not over 40, experienced in the design and selection of oil refinery or chemical plant "offsite facilities." These include storage tanks, product blending and loading facilities, cooling towers, drainage systems, boiler and utility plants and all connecting piping. Great opportunities for men with the right experience and initiative.

## SENIOR PIPING DESIGNER DRAUGHTSMEN

Applicants should have considerable experience in the design and layout of piping for the petroleum, petrochemical and related industries. Kellogg's advanced piping design techniques, which are being constantly developed and improved, together with the use of scale models, offer candidates exceptional opportunities to become leaders in this field.

## DESIGNER/DRAUGHTSMEN

### STRUCTURAL • ELECTRICAL • INSTRUMENT

Progressive positions in the Structural Division, Electrical Division, Instrument Division. Candidates should possess National Certificates or equivalent with design experience in the refinery, petrochemical or allied industry.

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*All these positions are permanent and offer well-paid careers with scope for advancement in a Company whose reputation is well known in the Petrochemical industries. Salaries are commensurate with academic qualifications and industrial experience. Free luncheon vouchers, contributory pension scheme, free life insurance benefits, generous overtime payments and a five-day week.*

Please write giving details of age and experience, etc., to Mr. R. H. Paterson,

**KELLOGG INTERNATIONAL CORPORATION**

**7-10 CHANDOS STREET, LONDON, W.1.**

Please quote Reference: HC. B 708

# 'Engineering' Appointments Section

## PUBLIC APPOINTMENTS

### THE COLLEGE OF AERONAUTICS
### ENGLISH ELECTRIC RESEARCH FELLOWSHIP IN AERONAUTICS

Applications are invited for a Research Fellowship which has been established at the College by the English Electric Company Limited. The Fellowship is intended to provide opportunity for post-graduate research into the problems of vibration or stability and control of aircraft and is tenable for one year beginning on or about 1st October, 1960. The value of the Fellowship is £750.

Applications giving full particulars of education and experience and quoting the names of three referees are required by 1st May, 1960, and should be addressed to:

THE WARDEN,
THE COLLEGE OF AERONAUTICS,
CRANFIELD,
BLETCHLEY,
BUCKS. B 485

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### THE COLLEGE OF AERONAUTICS

Applications are invited for the PERRING SCHOLARSHIP IN AERONAUTICS, valued at £500 per annum, tenable at The College of Aeronautics. The successful candidate will be admitted to the two-year course in Aeronautical Engineering and Science at the College, leading to the award of the College Diploma (D.C.Ae.).

Applicants should preferably be Honours graduates or final year under graduates in engineering, mathematics or physics; applications from non-graduates with comparable qualifications will also be considered. Candidates must be British subjects domiciled in the United Kingdom.

Forms of application and statement of conditions will be forwarded on written application to:

THE WARDEN,
THE COLLEGE OF AERONAUTICS,
CRANFIELD,
BLETCHLEY,
BUCKS.

The closing date for the receipt of applications is 18th May, 1960. B 486

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THE UNIVERSITY OF MANCHESTER

### POSTGRADUATE COURSE IN NUCLEAR ENGINEERING

This course, which is of one year's duration, is intended for graduate engineers, physicists, or metallurgists who wish to specialise in the field of Nuclear Engineering. Students attend a course of lectures on the fundamentals of the subject, supplemented by selected topics at a more advanced level, and also undertake an experimental project. The Diploma for Advanced Studies in Science is awarded to candidates who successfully complete the course. Application has been made to the Department of Scientific and Industrial Research for acceptance of the Postgraduate Course in Nuclear Engineering as suitable for the tenure of its Advanced Course Studentships.

All applications and enquiries should be addressed to PROFESSOR W. B. HALL, NUCLEAR ENGINEERING LABORATORIES, THE UNIVERSITY, MANCHESTER 13. B 423

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### DRAUGHTSMAN

Applications are invited for the above post, which located in Birmingham.

The work is interesting and varied and is mainly in connection with the design of industrial heating equipment. A knowledge of combustion technique and the use of refractories would, therefore, be an advantage.

Candidates should possess the Ordinary National Certificate in Mechanical Engineering as a minimum qualification.

The salary for the appointment, which is pensionable and subject to medical examination, will be within the range of £733-£853 per annum.

Applications, stating age, qualifications and experience, together with the names of two referees, should be addressed to the INDUSTRIAL RELATIONS OFFICER, WEST MIDLANDS GAS BOARD, 6, AUGUSTUS ROAD, EDGBASTON, BIRMINGHAM, 15. G 848

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### HUDDERSFIELD COLLEGE OF TECHNOLOGY

Principal: Dr. W. E. SCOTT, M.B.E.

### DEPARTMENT OF CIVIL AND MECHANICAL ENGINEERING

Applications are invited from graduates in Engineering for the post of SENIOR LECTURER to supervise project work carried out by full-time Sandwich Course students. Duty to commence as soon as possible. The candidate, who should have had research, industrial and teaching experience, should indicate the Mechanical Engineering subject which he would be prepared to reach up to Graduate level. Salary: Burnham Scale, £1550 p.a. by £50 p.a. to £1750 p.a. The commencing salary will depend upon previous experience.

Forms of application and further particulars obtainable from the PRINCIPAL, to whom applications should be returned without delay.

H. GRAY,
Clerk to the Governors. B 677

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### CITY OF CARLISLE
### CARLISLE TECHNICAL COLLEGE

Applications are invited for the following new posts which arise owing to expansion of the work of the College:—

"GRADE B" ASSISTANT IN PRODUCTION ENGINEERING, to teach Workshop Technology and Principles of Engineering Production. Applicants should be graduates or equivalent, and have had good industrial experience in production engineering. Salary £700 by £27 10s. to £1150.

"GRADE A" ASSISTANT IN WORKSHOP ENGINEERING, to teach Workshop Practice and technology. Workshop experience is essential, and candidates should possess a Full Technological Certificate in Machine Shop Engineering or H.N.C. in Mechanical Engineering. Salary £520 by £27 10s. to £1000 p.a.

Allowance will be made on the scale for approved industrial experience and qualifications.

Application forms and further particulars from the DIRECTOR OF EDUCATION, 19, FISHER STREET, CARLISLE. Closing date 12th April. B 654

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### SOUTH EASTERN GAS BOARD
### SHIFT ENGINEER AND SHIFT SUPERVISOR

ISLE OF GRAIN WORKS, KENT

Applications are invited for the above appointments at this Works which is newly constructed for the production of town gas from petroleum products, and is in course of expansion from its present capacity of 20 million cu. ft. per day to a capacity of 45 million cu. ft. per day, with provision for further extension.

The two main sections of plant comprise:—

(1) production and treatment of gas made in Segas plants;

(ii) manufacture of oxygen and the operation of high pressure gasification and treatment plant.

The Shift Engineer will be responsible to the Station Engineer for the general operation of the works during his shift and will be assisted in his duties by a Shift Supervisor.

Salaries within ranges:—

Shift Engineer, £1006-£1235 per annum.
Shift Supervisor, £946-£1071 per annum.

The Board will give assistance in connection with housing accommodation. Generous holidays and sick pay; contributory pension scheme.

Applications in writing quoting reference V15/1207 and giving full details, should reach the PERSONNEL MANAGER, SOUTH EASTERN GAS BOARD, KATHARINE STREET, CROYDON, within seven days. Applicants should state clearly for which of the above vacancies they wish to be considered. B 684

C E G B

*Your Opportunity in a Vital and Expanding Industry*

Applications are invited for the following appointments at
HEADQUARTERS DRAWING OFFICE
**Bankside House, Sumner Street, S.E.1**

SENIOR CIVIL ENGINEERING DRAUGHTSMEN — **Starting salary within the range £830 to £940 p.a.**

CIVIL ENGINEERING DRAUGHTSMEN — An opportunity for draughtsmen to obtain design experience which would eventually fit them for consideration for senior positions.

**Starting salary within the range £660 to £780 p.a.**

There are also vacancies for two **DRAUGHTSMEN** experienced in the preparation of graphs, charts, maps, lettering, etc., and for one **DRAUGHTSMAN ILLUSTRATOR** for line and art catalogue presentation. **Salaries within the range £565 to £740 p.a.**

Holiday arrangements honoured.

Permanent pensionable appointments.

Staff restaurant. Sports and Social Club.

**Applications stating age, qualifications, experience, present position and salary, to the Personnel Officer, 24/30, Holborn, London, E.C.1. Envelopes should be marked "Confidential Ref. ENG/121."** B 681

*Central Electricity Generating Board*

**THE GLACIER METAL CO. LTD.,**
*have a vacancy for an*
**ENGINEERING MANAGER**

to command a group of 13 engineers, draughtsmen, tracers, and clerks, engineering the high-speed production of thin-wall bearings. The person appointed will be responsible to the Unit Manager for all engineering aspects of production. This demands continuous review of the uses to which existing machines and equipment are put, and the development of machines and equipment in the longer term. The work requires an understanding of presses, plating plant, machine tools and high-speed transfer line techniques.

Requirements: Degree, A.M.I.Mech.E. or A.M.I.Prod.E.; apprenticeship or equivalent; several years experience in methods development close to production. Preferred age: 27-35. Must have the capacity to lead a team of engineers, be a source of good engineering ideas, and have the ability to influence operational managers to use the best methods.

Salary: £1100 to £1650 (probably starting in the lower half).

**PERSONNEL MANAGER (REF. 2595)**
**THE GLACIER METAL CO. LTD.**
**EALING ROAD**
**ALPERTON, WEMBLEY, MIDDX.** B 709

**STRUCTURAL STEELWORK INSPECTOR**

The Building and Structures Department of The Steel Company of Wales Ltd. invite applications for the position of Structural Steelwork Inspector.

He will organise and supervise labour engaged on the maintenance and development of structural steelwork, together with the inspection of this work.

Applicants who must be accustomed to working at heights should be craftsmen preferably with qualifications up to O.N.C. level. Experience of fabrication of Structural Steelwork and control of labour is essential.

*Please write giving full details of age, experience, qualifications, salary and any other relevant information to:—*

**SUPERINTENDENT**
**PERSONNEL SERVICES**
**THE STEEL COMPANY OF WALES LIMITED**
**(STEEL DIVISION)**
**ABBEY WORKS, PORT TALBOT**
**GLAMORGAN** B 710

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**DRAUGHTSMAN**
*(Plant and Factory Layout)*

Applications are invited for a new vacancy in the Works Engineer's Department concerned with a wide range of plant and factory layout and services.

Good experience in this field is necessary together with a minimum technical qualification of O.N.C. or equivalent.

The Company is expanding its activities and plant and this post offers good opportunities, together with a good commencing salary and conditions of service.

*Applications giving details of age, qualifications, experience and current salary should be sent to:—*

**THE PERSONNEL MANAGER,**
**THE MICANITE & INSULATORS CO. LTD.,**
**EMPIRE WORKS, BLACKHORSE LANE, WALTHAMSTOW,**
**LONDON, E.17** B 690

### ENGINEER OR PHYSICIST

D.S.I.R. HYDRAULICS RESEARCH STATION, WALLINGFORD, BERKS, requires ENGINEER OR PHYSICIST (Graded as Scientific Officer/Senior Scientific Officer) with interest in fluid mechanics, for work in field of Civil Engineering Hydraulics. Opportunities of undertaking both background and fundamental research and investigation of specific problems. Favourable housing prospects for married officer. Quals.: 1st or 2nd Class Honours degree in Physics or Engineering or equivalent. At least 3 years post-graduate experience required for S.S.O. Salary ranges: (men) S.O. £615-£1090; S.S.O. £1166-£1380.—Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting E.129/OA. B 675

### CITY OF CARDIFF EDUCATION COMMITTEE
### LLANDAFF TECHNICAL COLLEGE

Principal: J. COTTERELL, M.I.E.E., A.M.I.Mech.E.

REQUIRED FOR 1st SEPTEMBER, 1960

1. LECTURER IN MECHANICAL ENGINEERING
To teach to National Certificate level and to be responsible for the development and organisation of the Mechanical Engineering Laboratories.
2. LECTURER IN PRODUCTION ENGINEERING
To teach Production Engineering subjects in National Certificate and City and Guilds Courses, and to be responsible for the organisation and development of the work which will include a new machine shop and metrology laboratory.

Applicants should possess a degree or equivalent professional qualification and have had comprehensive experience in industry and considerable teaching experience.
SALARY SCALE:—
Lecturer: £1370 by £35 and final one of £40 to £1550 per annum.
Application forms and further particulars may be obtained from the undersigned, to whom completed applications should be forwarded by 20th April, 1960.

ROBERT E. PRESSWOOD,
Director of Education.
CITY HALL,
CARDIFF. B 691

### COUNTY BOROUGH OF BRIGHTON EDUCATION COMMITTEE
### BRIGHTON TECHNICAL COLLEGE

Required for 1st September
LECTURER in Civil Engineering subjects, preferably Theory of Structures and/or Hydraulics to degree and professional levels. Applicants must hold a good degree in Engineering. Corporate membership of the Institution of Civil Engineers an advantage. Teaching and professional or research experience desirable.
Salary scale: £1370 by £35 (4) and £40 to £1550. Increments may be allowed for approved experience of equivalent standard.
Further particulars and application forms from the undersigned. Completed forms to be returned to the PRINCIPAL, BRIGHTON TECHNICAL COLLEGE, RICHMOND TERRACE, BRIGHTON 7, by 23rd April.

W. G. STONE,
Director of Education. B 689

### NEWCASTLE UPON TYNE EDUCATION COMMITTEE
### RUTHERFORD COLLEGE OF TECHNOLOGY

(SELECTED FOR DEVELOPMENT INTO A COLLEGE OF ADVANCED TECHNOLOGY)

The Governors invite applications for the undermentioned posts which arise due to the expansion of the College and to increase the opportunities for research and similar undertakings. In all cases duties will commence on 1st September, 1960.
The College is concerned almost exclusively with advanced courses leading to external degrees, professional membership, H.N.C., H.N.D., Dip. Tech. and Post-Graduate courses.
DEPARTMENT OF MECHANICAL ENGINEERING:—
(i) PRINCIPAL LECTURER: Candidates should have high academic qualifications together with several years advanced teaching experience, a good industrial background and, preferably, some research experience.
(ii) SENIOR LECTURER (5 POSTS): Candidates should be, at least, honours graduates with good teaching and industrial experience. An interest in research would be helpful together with the ability and experience to play an active part in the development of courses concerned with Heat Transfer, Aerodynamics, Fluid Mechanics, Engineering Design, Vibrations, Combustion Engineering, Reactor Engineering.
(iii) LECTURER (6 POSTS): Candidates should be graduates with good industrial and, preferably, some teaching experience. They should be prepared to teach some of the following subjects to, at least, H.N.C. level: Heat Engines, Theory of Machines, Fluid Mechanics, Production Processes, Strength of Materials.
Salary will be in accordance with the Burnham Technical Report:—
Principal Lecturer: £1750 by £50 to £1900.
Senior Lecturer: £1550 by £50 to £1750.
Lecturer: £1370 by £35 (final £40) to £1550.
Further particulars and form of application (returnable by 16th April) may be obtained from the PRINCIPAL, RUTHERFORD COLLEGE OF TECHNOLOGY, NORTHUMBERLAND ROAD, NEWCASTLE UPON TYNE, 1. B702

### EXPERIMENTAL OFFICERS

D.S.I.R. HYDRAULICS RESEARCH STATION, WALLINGFORD, BERKS., requires ASSISTANT EXPERIMENTAL/EXPERIMENTAL OFFICERS for work on scale models of hydraulic projects in civil engineering field. Quals.: G.C.E. "A" level in two science or science and maths. subjects or equivalent. Over 22, pass degree H.N.C. or equivalent generally expected. Experience of engineering drawing and/or constructional work an advantage for some posts. Age at least 26 for Experimental Officer. Starting salary ranges: A.E.O. £382 10s. (age 18)—£670 (age 26 or over)—£830. E.O. £954—£1166.—Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting E137/OA. B 698

### LECTURERS

UNIVERSITY COLLEGE LONDON (Gower Street, W.C.1) requires two LECTURERS in Department of Civil and Municipal Engineering with special reference to subjects in general field of Structures and Strength of Materials including Soil Mechanics. Duties to commence 1 October, 1960. Applicants must have university degree. Preference will be given to those having experience of research and postgraduate supervision. Experience in engineering work outside a university is desirable. Salary within range £900-£1650, plus £60 London allowance, with superannuation and family allowance. Initial salary according to qualifications and experience.—Further particulars may be obtained from the SECRETARY, to whom applications should be addressed by 30 April, 1960. B 678

### NORTHAMPTON COUNTY BOROUGH EDUCATION COMMITTEE
### NORTHAMPTON COLLEGE OF TECHNOLOGY

Applications are invited for the following full-time appointments in the Engineering Department, duties to commence 1st September, 1960.
(1) ASSISTANT (GRADE B) for MECHANICAL AND PRODUCTION ENGINEERING subjects.
(2) ASSISTANT (GRADE B) to teach PRODUCTION ENGINEERING subjects up to Final Machine Shop Engineering and Higher National Certificate standard.

Further particulars and forms of application may be obtained from the undersigned to whom completed forms should be returned within two weeks of the appearance of this advertisement.

H. A. SKERRETT,
Chief Education Officer.
BOROUGH EDUCATION OFFICE,
"SPRINGFIELD,"
CLIFTONVILLE,
NORTHAMPTON. B 723

### PETERBOROUGH JOINT EDUCATION BOARD
### PETERBOROUGH TECHNICAL COLLEGE

Required for September, 1960: LECTURER IN CIVIL ENGINEERING mainly for Higher National Certificate work. Degree or equivalent essential; teaching and/or industrial experience desirable. Principal subjects: Theory and Design of Structures, Surveying and Geology and Soil Mechanics. Salary in accordance with the Burnham Technical Scales:
£1370 by £35 to £1550 per annum.
Further particulars and forms of application obtainable from THE PRINCIPAL, PETERBOROUGH TECHNICAL COLLEGE, EASTFIELD ROAD, PETERBOROUGH, to whom completed forms should be returned as soon as possible. B 722

### CIVIL ENGINEERS

MINISTRY OF TRANSPORT: CIVIL ENGINEERS. Pensionable posts for men and women at least 25 and under 35 on 1.1.60 (extension for regular Forces service, Overseas Civil Service, established civil service, and temporary Government service as Civil Engineer). Candidates must have achieved Corporate Membership of Institution of Civil Engineers or passed examinations necessary for attaining such membership. Experience in road and bridge construction essential; knowledge of Highways Authorities' procedure desirable. Starting salary (men, London) from £830 to £1125 according to age. Scale maximum (London) £1300. Promotion prospects.—Write CIVIL SERVICE COMMISSION, 17, NORTH AUDLEY STREET, LONDON, W.1, for application form, quoting S/64/8. B 711

### UNIVERSITY OF BIRMINGHAM
### ESSO STUDENTSHIP IN CHEMICAL ENGINEERING

Applications are invited from men who hold or expect to hold a good University degree in Chemical or other branch of Engineering or in Chemistry for the Esso Studentship, founded by the Esso Petroleum Company Limited, tenable in the Department of Chemical Engineering at Birmingham University during the year beginning in October, 1960.
The value of the Studentship is £400 a year plus University fees. Subject to a satisfactory report of the work performed, the Studentship will be renewed for a second year.
Applications should be submitted to the REGISTRAR, UNIVERSITY OF BIRMINGHAM, EDGBASTON, BIRMINGHAM 15, by 1st July, 1960, giving full particulars of educational qualifications, industrial experience (if any), national service, and outside interests, together with the names of two referees. B 712

### IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

### ESSO STUDENTSHIP IN CHEMICAL ENGINEERING

Applications are invited from men who hold or expect to hold an honours degree in Chemistry or Engineering for the Esso Studentship, founded by the Esso Petroleum Company Limited, tenable in the Department of Chemical Engineering at the above College from October, 1960. The value of the Studentship is £400 a year plus College fees.

Applications should be submitted to the REGISTRAR, IMPERIAL COLLEGE, LONDON, S.W.7, by 29th April, giving full particulars of previous industrial experience (if any), national service, and academic qualifications. The names of two referees should also be given. B 714

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### UNIVERSITY OF LONDON

### READERSHIP IN ELECTRIC TRACTION AT IMPERIAL COLLEGE

The Senate invite applications for the READERSHIP IN ELECTRIC TRACTION tenable at the Imperial College of Science and Technology (salary £1475-£1775-£2150 a year plus £80 London Allowance). Knowledge of Electrical Engineering including machines is of more importance than extent of experience in Traction.—Applications (10 copies) must be received not later than 13 May, 1960, by the ACADEMIC REGISTRAR, UNIVERSITY OF LONDON, SENATE HOUSE, W.C.1, from whom further particulars may be obtained. B 720

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### CITY OF SHEFFIELD EDUCATION COMMITTEE COLLEGE OF TECHNOLOGY DEPARTMENT OF ENGINEERING

Applications are invited for the following posts:—

(*a*) SENIOR LECTURER IN PRODUCTION ENGINEERING to teach Machine Tool Theory, Metrology and other subjects of the new scheme of the Institution of Production Engineers to Higher National Diploma students, to be responsible for the new, very well-equipped Machine Tool and Metrology laboratories, to assist in the promotion of research and laboratory work and in organising special advanced courses in production subjects. An interest in the application of automatic control to manufacturing equipment will be welcomed.

SALARY: £1550 by £50 to £1750 per annum.

(*b*) LECTURER IN ENGINEERING MATHEMATICS to teach Mathematics to Ordinary National Certificate and Higher National Certificate students. Interest in teaching Statistics and Computation will be welcomed. Ability to develop a Mathematics Laboratory would be a recommendation.

SALARY: £1370 by £35 to £1550 per annum.

(*c*) ASSISTANT (GRADE B) IN MECHANICAL ENGINEERING (two posts) to teach mainly in part-time day Ordinary National Certificate classes a selection from Engineering Science, Applied Mechanics, Engineering Drawing, Workshop Technology (Production Processes), Mathematics and Applied Heat. More advanced work will be available for a suitably qualified or experienced teacher.

Salary: £700 by £27 10s. 0d. to £1150 with appropriate additions for degree and training.

(*d*) ASSISTANT (GRADE B) IN MOTOR (AUTOMOBILE) ENGINEERING to take classes in Motor Vehicle Technology, Calculations, Science, Drawing and Garage Practice for Motor Vehicle Mechanics and Motor Vehicle Technicians.

SALARY: £700 by £27 10s. 0d. to £1150 with appropriate additions for degree and training.

All appointments will date from 1st September, 1960. Applicants for the above posts should hold graduate or other suitable qualifications, and be adequately experienced in industry and teaching.

Application forms, obtainable from the undersigned (s.a.e.) at P.O. BOX 67, SHEFFIELD, 1, should be returned within 14 days of the appearance of this advertisement.

T. H. TUNN,
Director of Education. B 719

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### UNIVERSITY COLLEGE, LONDON

### ESSO STUDENTSHIP IN CHEMICAL ENGINEERING

Applications are invited from men who hold or expect to hold a good University degree in Chemical or other branch of Engineering or in Chemistry for the Esso Studentship, founded by the Esso Petroleum Company Limited, tenable at the Ramsay Memorial Laboratory of Chemical Engineering at the above College during the year beginning in October, 1960.

The value of the Studentship is £400 a year plus College fees. Candidates must either be engaged in or preparing to enter the petroleum or chemical industry. Subject to a satisfactory report on the work performed, the Studentship will be renewed for a second year.

Applications should be submitted to the REGISTRAR, UNIVERSITY COLLEGE, GOWER STREET, LONDON, W.C.1, by 13th May, 1960, giving full particulars of educational qualifications, industrial experience (if any), national service, and outside interests, together with the names of two referees. B 713

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## APPOINTMENTS OPEN

### ENGINEER

Fully qualified ENGINEER to be directly responsible to the Partners required by medium-sized firm of Consulting Engineers in Westminster. Should have had varied civil and structural engineering experience including road, bridge and railway works. Age 35-45. —BOX B 577, Offices of ENGINEERING.

### RICHARD THOMAS & BALDWINS LIMITED

## TECHNICAL STAFF

## FUEL ENGINEERS

Fuel Engineers are required to be based at the Company Central Engineering Department, Spencer Works, Llanwern, Newport, Mon., for work in connection with new projects at the Company's Works, but particularly with the new fully integrated works under construction at Llanwern. Applicants must have extensive experience of fuel technology as applied to iron and steel production, with particular reference to gas distribution control, steam production and distribution, and to furnace practice. A sound technical education is required.

## INSTRUMENTATION ENGINEERS

Instrumentation Engineers are required in the Company Central Engineering Department mentioned above, for work in connection with preparation of, and supervision of installation of instrumentation schemes at the Company's works, in particular at the new Spencer Works at Llanwern, near Newport, Mon.

Applicants should be thoroughly familiar with the application of modern techniques and equipment to iron and steel production processes.

Salary scales commensurate with qualifications and experience.

Contributory Staff Pension and Life Assurance Scheme.

Applications in confidence, should be addressed to—

"The General Manager—Engineering,
Company Central Engineering Department,
Spencer Works,
Richard Thomas & Baldwins Limited,
Llanwern, Newport, Mon."

the envelope to be endorsed "Fuel Engineer" or "Instrumentation Engineer" as appropriate, in top left-hand corner. B 626

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### MAINTENANCE AND DEVELOPMENT ENGINEER

MAINTENANCE AND DEVELOPMENT ENGINEER required by HAWTHORN LESLIE (SHIP BUILDERS), LTD., HEBBURN UPON TYNE. Sound experience of plant installation and maintenance essential. Applications to General Manager giving age also particulars of training and experience. B 613

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### ASSISTANT ENGINEER

ASSISTANT ENGINEER for work in connection with site investigations and soil mechanics laboratory required immediately by CONSULTING ENGINEERS, F. R. BULLEN & PARTNERS, DACRE HOUSE, DEAN FARRAR STREET, LONDON, S.W.1. B 620

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### DRAUGHTSMAN

Modern Paper Mill in the South of England requires ENGINEERING DRAUGHTSMAN. O.N.C. standard. Capable of plant layout and piping arrangements. Ability to work with minimum supervision. Non-contributory pension scheme. Canteen facilities.—Full particulars to BOX B 631, Offices of ENGINEERING.

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### GRADUATE MECHANICAL ENGINEER

GRADUATE MECHANICAL ENGINEER with Hons. degree required by London Consulting Engineers specialising in design of Pump Stations, Pipelines, Oil Storage Depots, etc., in the U.K. and abroad. Age 25-35. Salary in accordance with age and qualifications.—Apply: PENCOL, 19, GROSVENOR PLACE, S.W.1. B 666

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### ASSISTANT ELECTRICAL ENGINEER

ASSISTANT ELECTRICAL ENGINEER, age 25/40, with B.Sc. or equivalent qualification required by large Board Mill in West of England generating own power requirements. Appointment is pensionable. Successful applicant will be responsible under Electrical Engineer for maintenance and development work. Some knowledge of heavy industry an advantage.—Full details of qualifications and experience to BOX B 671, Offices of ENGINEERING.

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### CIVIL ENGINEERS

Applications are invited for the appointment of a SENIOR and JUNIOR ENGINEER with previous experience in reinforced concrete design and construction.

These vacancies occur in design office for interesting and varied industrial work.

Apply quoting Ref. "SAR," to MERZ AND McLELLAN, CARLIOL HOUSE, NEWCASTLE UPON TYNE, 1. B 687

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## SITE ENGINEER

### (Mechanical and Electrical)

required by the N.C.B. at the Penallta Power Station, South Wales, to supervise the installation of a small power plant. The appointment initially will be for a minimum of two years; there may be continuity of work beyond this period in South Wales. Applicants should be qualified engineers with previous experience in the construction and erection of water tube boilers, turbo-alternators and auxiliaries, including electrical equipment. Duties will include the administration of the site as well as the co-ordination between the various plant contractors, and liaison with the Board's Civil Clerk of Works on the site. Salary according to qualifications and experience within £780-£940. Write to:—

STAFF DEPARTMENT (X1735C)
NATIONAL COAL BOARD
HOBART HOUSE, LONDON, S.W.1

for application form which should be returned by 11th April, 1960. B 701

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## MINISTRY OF POWER

## Inspectorate of Nuclear Installations

Up to 12 pensionable posts as **INSPECTOR** are to be filled in a new organisation in London being set up under Nuclear Installations (Licensing and Insurance) Act, 1959. The duties will include the safety assessment of all proposals for Nuclear Installations and the inspection of such installations during construction, commissioning, and operation.

There are vacancies for mechanical, electrical, instrument and control engineers, physicists and a chemist or metallurgist.

Candidates must be at least 30 on 1st April, 1960, and normally have an honours degree in engineering, physics, chemistry, metallurgy, or mathematics, or have achieved corporate membership of an appropriate professional institution. They must also have had at least 5 years' experience, at a responsible level, of design, research, operation, or inspection, connected with large scale chemical or engineering plant. Previous experience of nuclear plants an advantage but not essential. These posts are for men only.

Salary scale £1325-£1780. Starting salary may be above minimum. There are prospects of promotion.

For particulars and application form apply to:—

CIVIL SERVICE COMMISSION
17 NORTH AUDLEY STREET
LONDON, W.1

quoting S/5120/60/13. Closing date 10th May, 1960. B 697

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## ASSISTANT CHIEF DOCKS ENGINEER

### BRITISH TRANSPORT DOCKS

Applications are invited for the position of ASSISTANT CHIEF DOCKS ENGINEER, Southampton Docks. Applicants should preferably have had experience in the design, construction, maintenance and operating of mechanical and electrical equipment in docks, including dry dock pumps, cranes and electrical sub-stations. Corporate Membership of one of the recognised Engineering Institutions is essential. Salary range £1950/£2350 per annum. Contributory Superannuation Scheme.

Applications should be forwarded to:—

STAFF AND ESTABLISHMENT OFFICER
BRITISH TRANSPORT DOCKS
163, EUSTON ROAD, LONDON, N.W.1

not later than 7th April, 1960. B 717

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## SENIOR MECHANICAL ENGINEER

A senior mechanical engineer is required by a Company engaged in a continuous process industry. The successful candidate will become a member of a management team connected with the management of a large factory. It is essential that candidates have:

(*a*) A good degree in Mechanical Engineering.
(*b*) Some background in heavy Engineering.

This vacancy is a particularly attractive one for the right calibre person and the future holds out very good prospects. The age limit is 35.

*A good commencing salary is offered and write stating full details, age, qualifications and experience to:—*

BOX B 673, Offices of ENGINEERING

## THE UNIVERSITY OF BRITISH COLUMBIA

Applications are invited for the position of

## ASSISTANT PROFESSOR

in the Department of Mechanical Engineering. Applicants should possess a good research degree and have an interest in thermodynamics, combustion and heat transfer. The appointee will be expected to actively pursue a programme of research in his field of interest, and to supervise graduate students as well as do undergraduate teaching.

Please submit full details with application, including references, which may be addressed to—

Head, Department of Mechanical Engineering,
University of British Columbia,
Vancouver 8, B.C.

B 609

## DESIGN DRAUGHTSMEN

### STEEL, PEECH & TOZER,

**branch of the United Steel Cos. Ltd.,**

have vacancies for first class **DESIGN DRAUGHTSMEN** capable of the layout and design of steelworks plant and equipment. The positions offered are permanent and present good opportunities to men of ability and initiative. Good working conditions, 38-hour week, and excellent superannuation scheme. Salary according to experience and qualifications.

Applications should be made in writing to:—

THE LABOUR MANAGER
STEEL, PEECH & TOZER
THE ICKLES, ROTHERHAM

B 694

# WIMPEY

## MATERIAL TAKE-OFF (MECHANICAL) ENGINEERS

required for London Office engaged in the Design and Procurement of Oil Refinery and Petrochemical Plants. Applicants must be capable of computing requirements from flow sheets and making accurate assessments of group and classification from detailed drawings.

Permanent positions. Pension Scheme after probationary period. Canteen facilities. First class office conditions.

Apply in writing to:—

**GEORGE WIMPEY & COMPANY LIMITED**
**Special Projects Office**
**191A Askew Road, Shepherd's Bush, London, W.12**

B 679

# Development Engineer

aged 30/40, required for a substantial and rapidly growing concern in the heavy chemical field located in the North of England.

A good Engineering degree is essential, together with experience in experimental and development work in medium engineering associated with chemical plants. A good knowledge of handling of corrosive liquids and gases and thermodynamics is also required. Those unable to satisfy these requirements need not apply.

The successful candidate will be expected to deal with specific technical problems and will be required to suggest and study new developments and practices.

This is a responsible position for which a commensurate salary will be paid.

A sound non-contributory Life Assurance and Pension Scheme is in operation. Bonus Scheme. Housing assistance to married men. 5-day week.

***Applications giving full details, i.e. age, education and experience, should be addressed to Box G. 851, Offices of Engineering.***

# GKN

## GROUP RESEARCH LABORATORY

The Mechanical Engineering Division of the Research Laboratory undertakes research and development work for the many companies within the G.K.N. Group. As the companies are engaged in many activities from steel making to light engineering on a very large scale, investigations are on many and varied topics.

The Division requires:—

**A DESIGN ENGINEER** for work on the design of light machine tools and similar work, who must be capable of developing workable schemes from requirements. Minimum age 28 years. Salary range £1000-£1300 p.a. (Ref. ME/1.)

**AN ENGINEERING ASSISTANT** who must be a qualified engineer, preferably with an honours degree. He must have completed his practical training and be between 24 and 30 years of age. Salary range £850-£1200 p.a. (Ref. ME/2.)

Applications in writing for either of these appointments, giving details of qualifications, experience, etc., should be addressed, quoting reference number, to:—

THE RECRUITMENT OFFICER
G.K.N. GROUP RESEARCH LABORATORY
BIRMINGHAM NEW ROAD
LANESFIELD, WOLVERHAMPTON

B 683

## JOSEPH LUCAS LIMITED

### GROUP RESEARCH CENTRE

The Metal Treating Department of the Group Research Centre is concerned with research and development on metal treating processes which involve heat treatment, diffusion and electrical discharge.

*Applications are invited for the following vacancies for*

# RESEARCH OFFICERS

**1** To take responsibility for initiating and developing metallographic techniques which are required for the examination of treated materials, and to be responsible for the application of recent and novel methods of structure examination. The successful applicant should be of graduate or A.I.M. level and it is expected that he will eventually lead a team on this work. A four-figure salary will be paid to suitable applicants.

**2** A physicist with an electronic or electrical engineering interest is needed for a team which will be engaged on the application of electrical discharge methods in metal treating processes. Applicants should be of graduate level but consideration will be given to men with suitable background and experience.

*Apply in writing, stating age, qualifications and experience, to the*
**Personnel Manager,**

## JOSEPH LUCAS LIMITED,

**Great King Street, Birmingham, 19**
**quoting Reference PM/GR/434**

B 704

## HICKSON & WELCH LIMITED

**Castleford, Yorkshire**

manufacturers of organic chemicals, have the following vacancies in the Engineering Department:—

**PROJECT ENGINEERS.** We wish to employ two project engineers whose duties will be to take charge of new developments from their conception through planning, design, siting, choice of equipment, installation and commissioning to full production. We are looking for top class qualified men and will pay the necessary salaries to get them.

**DESIGN DRAUGHTSMEN.** We require two or more design draughtsmen to work in conjunction with the Project Engineers described above. They should be capable of accurately interpreting the Project Engineer's ideas on the drawing board. We will pay such salaries as are required to attract the right men.

**SERVICES ENGINEER.** A Services Engineer is required to maintain and improve the supply of all services except electricity to our plants, to anticipate future requirements and make plans to ensure that they are met. We have in mind a starting salary of the order of £1300 a year but those whose qualifications and experience merit a greater salary are encouraged to apply.

*Please address your enquiries to the Chief Engineer.*

B 707

# ENGLISH ELECTRIC

**WHETSTONE, NEAR LEICESTER**

Openings have arisen in the New Development and Process Department for

## A MACHINE TOOL DESIGNER

to tackle a whole range of problems associated with the production of

**NUCLEAR REACTOR FUELLING MACHINERY**
**STEAM TURBINES AND GAS TURBINES**

Applications are invited from professionally qualified engineers with experience in the design and development of special purpose machine tools.

## A BUILDING & SERVICES ENGINEER

to work on the initiation, layout and specification of new building projects and services. The successful applicant will also have some responsibility for the vetting of design schemes and construction projects.

Applicants should possess suitable qualifications in this field together with appropriate professional training.

The posts are permanent and pensionable and normal staff facilities are available.

Please write to:—

**TECHNICAL STAFF OFFICER**
**DEPARTMENT C.P.S.**
**MARCONI HOUSE**
**336-337 STRAND**
**LONDON, W.C.2**

quoting reference EG 1896K. B 686

# Mechanical engineer

*wanted for permanent employment in the*

United States

Experience in the design of equipment used in the steel, brass, or aluminium mills desirable, although not essential.

Design work should have included hydraulics as well as mechanics. The applicant must be capable of making stress analyses of machine linkages. He must have been in charge of a drafting room of not less than five men. A man with good engineering background and production sense is preferred.

Please send complete educational as well as employment resume. Salary will be £2500 per year or up, depending on experience and capability. Candidates will be interviewed in London during May.

Replies to be sent to

**MILL ACCESSORIES, INCORPORATED,**
**BOX 1890, NEW HAVEN, CONNECTICUT**

B 665

**SENIOR DESIGN ENGINEER**
and
**DESIGN ENGINEER**
are required by the Production Group of the
**UNITED KINGDOM ATOMIC ENERGY AUTHORITY at WINDSCALE WORKS CUMBERLAND**

to undertake the design and layout of a wide range of mechanical and chemical engineering equipment. This includes light and heavy chemical plant and mechanical services to Nuclear Reactors.

Applicants must have served a recognised engineering apprenticeship or have had comparable training and be corporate members of the Institution of Mechanical Engineers or equivalent.

In addition, applicants for the senior post should have the experience and personal qualities necessary to lead a large team of professional and supporting staff. A good general engineering background of several years in a responsible position is essential.

Salaries are within the following ranges, according to qualifications and experience:—

Senior Design Engineer, £1880-£2180 p.a.

Design Engineer, £1370-£1825 p.a.

Contributory Superannuation.
Staff Housing Scheme.

Send postcard for application form, quoting reference P/W.17/J2, to: Recruitment Officer, Windscale Works, Sellafield, Seascale, Cumberland.

**Closing Date: 11th April 1960**

B 663

# WHESSOE LIMITED

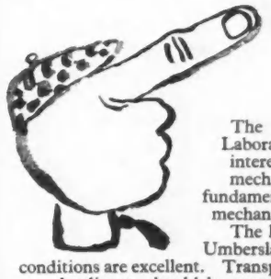
**Darlington**

require a young man in his middle twenties to join an energetic group working on welding and metallurgical development, to specialise in developing ultrasonic techniques for weld inspection, preferably with experience in this field. A degree is preferred, but candidates with H.N.C. or "A" level physics may be considered if they have relevant experience.

Send detailed applications to:—

THE STAFF OFFICER
WHESSOE LIMITED
DARLINGTON

quoting Reference 11/60A and mentioning this paper. B 700



# Research and Development Designers

The Mechanism Division of Wilmot Breeden Laboratories has vacancies for senior designers interested in the evolution and development of mechanisms. The work includes the study of fundamentals of mechanism and the development of mechanisms for the European motor industries.

The laboratories are in ideal surroundings at Umberslade Park, near Hockley Heath. Working conditions are excellent. Transport is available to and from the establishment.

Applicants should be prepared to make occasional journeys to the Continent. Competitive salaries are offered, and there is a staff pension scheme.

Applications, which will be treated in strict confidence, should give full details of age, qualifications and experience, and be addressed to:—

Chief Development Engineer,
Wilmot Breeden Laboratories,
Umberslade Park, Solihull, Warwickshire. B 662

**WILMOT BREEDEN LABORATORIES**

# SENIOR BUYER

A senior appointment in the buying field exists with a major industrial company with its Head Offices in London. Applicants should have a wide and varied experience of buying in the engineering industry and be capable of negotiating at management level. The need is for a good calibre man aged up to 35. Future prospects are extremely bright for a candidate with the right potential.

*Write stating full particulars to:—*

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## Senior Draughtsman

A Senior Draughtsman is required to deal with Spares and Repairs in the Drawing Office dealing with a range of steam and gas turbines.

Applicants should have long experience in the turbine industry preferably on Drawing Office contract work. Initially the successful applicant would be required to spend some time away from the works during the transfer of records from their existing location.

The Company is pleasantly situated in the Cotswolds and has a housing scheme in operation.

*Applicants should write in the first instance giving full details of age, experience and qualifications to:—*

**THE PERSONNEL OFFICER**
**HAWKER SIDDELEY BRUSH TURBINES LIMITED**
**HUCCLECOTE, GLOUCESTER**

B 688

**A LARGE COPPER MINE IN THE**

**RHODESIAN SELECTION TRUST GROUP**

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## SENIOR ELECTRICAL ENGINEER

Applicants should hold a degree in Electrical Engineering and have had subsequent experience in heavy engineering work. They should preferably be under 35 years of age.

Duties will consist of planning engineering projects of a varied nature in connection with large scale mining operations including power generation and distribution, mine shafts and haulage, ore treatment, smelting and other associated heavy engineering plant.

Basic starting salary from £1750 p.a. depending on qualifications and experience. There is also a bonus scheme at present paying 33 per cent. on basic pay and a variable cost of living allowance, currently, £65 p.a. The company has generous pension, life assurance and medical schemes and it also operates share purchase and house purchase arrangements.

Leave at 51 days p.a. may be accumulated over three years' service.

The outward passages for the employee and his family would be paid by the company.

Full particulars covering age, qualifications and experience should be sent in confidence to:

**The Overseas Personnel Officer,**
**SELECTION TRUST LIMITED**
**Mason's Avenue · Coleman Street,**
**London, E.C.2**

*Please quote R.7/EG.* B 647

## UNIVERSITY OF CAMBRIDGE

**FACULTY OF ENGINEERING**

There are vacancies for

**UNIVERSITY LECTURERS**

particularly in the fields of Mechanism, Theory of Structures, and Electricity.

Application forms and further information from the Secretary of the Department, Engineering Laboratory, Cambridge.

*Closing date 25 April 1960*

B 695

## MECHANICAL INSTRUCTORS

**The Steel Company of Wales Ltd.,**

as part of an expanding Apprentice Training Scheme, have built a new Training Centre, fully equipped with up-to-date machines. Three additional Mechanical Instructors are therefore required to assist the Apprentice Master with the practical training of apprentices.

Applicants must have experience in machine shop engineering and their qualifications should be up to Final City and Guilds level, with the Ordinary National Certificate as an additional advantage. The ability to instruct is of prime importance.

*Please write giving full details of age, experience, qualifications and any other information considered relevant, to:—*

**SUPERINTENDENT, PERSONNEL SERVICES**

**THE STEEL COMPANY OF WALES LTD.**

**(STEEL DIVISION), ABBEY WORKS, PORT TALBOT, GLAM.**

B 672

### ASSISTANT PROJECT ENGINEERS

SCHWEPPES LTD. An opportunity exists for TWO ASSISTANT PROJECT ENGINEERS to work with a small enthusiastic team on the planning, and installation of new machinery to suit existing and new processes being developed. The work would cover the improvement of existing factories and machinery, and the planning and supervising of complete process plant installations in some twenty factories in Great Britain. Only applicants having an Engineering Degree or Higher National Certificate approaching A.M.I.Mech.E. standard with at least two years practical training and some drawing office experience, preferably on the works engineering side, will be considered. Approximate age limits 28-35. The successful applicant would be based in London but expected to travel to all factories.—Application in writing giving brief details of experience, present position and salary should be addressed to PERSONNEL MANAGER, SCHWEPPES LTD., SCHWEPPES HOUSE, 1/6 CONNAUGHT PLACE, W.2. B 685

### ENGINEER

ENGINEER required by leading ENGINEERING INSURANCE COMPANY, for inspection of Cranes and Lifting Plant. Must have drawing office experience of design of Cranes, also National Certificate in Mechanical Engineering. Liverpool. Starting salary £800 p.a. Other benefits. Permanent.—Write BOX E199, L.P.E., ROMANO HOUSE, 399/401 STRAND, LONDON, W.C.2. B 676

### R.C. DETAILERS

CONSULTING ENGINEERS require R.C. DETAILERS; minimum three years experience. Permanent position. Pension scheme, luncheon vouchers.—Send details of experience and salary required to F. R. BULLEN & PARTNERS, DACRE HOUSE, DEAN FARRAR STREET, WESTMINSTER, S.W.1. B 703

### MECHANICAL ENGINEERING DRAUGHTSMEN AND DRAUGHTSMEN/DESIGNERS

UNILEVER LIMITED invite applications for the appointment of MECHANICAL ENGINEERING DRAUGHTSMEN AND DRAUGHTSMEN/DESIGNERS in their London Office. Qualifications equivalent to Higher National Certificate preferred and some Workshop training is essential. Experience required in layout drawings for processing equipment and design of vessels and pipework. Starting salaries according to age and experience.—Written applications giving full particulars of qualifications, training and experience to be addressed to HEAD OFFICE STAFF DEPARTMENT (WF53), UNILEVER HOUSE, LONDON, E.C.4. B 696

### WORK STUDY OFFICER

LAPORTE CHEMICALS LIMITED, WARRINGTON, require a WORK STUDY OFFICER with experience of Work Study techniques and cost control. The job will involve work on chemical processes and engineering maintenance. Age between 30 and 45 years. Good salary will be paid commensurate with age and experience. A pension scheme is in operation. In selected cases, assistance can be given towards removal expenses and house purchase.—Applications, giving details of age, qualifications and experience, and quoting Ref. LCW/E1/24, should be addressed to THE GROUP PERSONNEL MANAGER, LAPORTE INDUSTRIES LIMITED, HANOVER HOUSE, 14, HANOVER SQUARE, LONDON, W.1. B 692

## APPOINTMENTS WANTED

### EXPERIENCED STAFF AVAILABLE

EXPERIENCED STAFF for hire in all branches of engineering.—Please phone AMB 8189. B 591

## 'Engineering' Appointments Section

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| Rates per page: (12 in. by 9 in.) | £100 |
| half page | £54 |
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(b) Semi-display: type matter, with or without surrounding rule, name block or symbol.

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| Rates: per page (12 in. by 9 in.) | £100 |
| half page | £54 |
| quarter page | £29 |
| single column inch | £2 14s. |

(c) Single column "run-on" advertisements: approximately 6 words to the line, 12 lines to the inch

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| Rate per line | 4s. 6d. |

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SERIES DISCOUNTS: 5 per cent. on 6 insertions; 10 per cent. on 13; 15 per cent. on 26.

BOX NUMBER: 2s.

COPY DATE: First post Monday.

BLOCKS: To be mounted ready for printing. Screen 100.

ORDERS TO: "Engineering" 36, Bedford Street, London, W.C.2. (Telephone TEMple Bar 3663)

# Companies

## Freer Trade in Central America

Although the attempts to free trade in Western Europe have been very well documented, a similar exercise in Central and South America has passed almost unnoticed in the British press. What in fact are the two Latin American Free Trade Areas? Many of the answers are given in a booklet recently reprinted by the Association of British Chambers of Commerce. In Central America the idea of a Central American free trade area was discussed early in 1956 at a conference of the Committee for Economic Co-operation in Central America, a United Nations sponsored body. Events since then have moved quickly. A draft treaty for a Free Trade Area and Economic Integration in Central America has been signed and ratified. This covers El Salvador, Guatemala, Nicaragua, Costa Rica and Honduras. The last two governments have not yet finally come into the scheme. The Central American Agreement is designed to eliminate customs duties on some 200 subheadings in the Unified Central American Tariff Nomenclature. The main items covered include foodstuffs, beer, tobacco, raw materials, chemicals, machinery and transport equipment and some manufactured products. Apart from goods on the free list, other items imported from the signatory states will get More Favoured Nation treatment. Some 40 per cent of the goods concerned are in fact items already traded between the member states and only some 3½ per cent of British exports are affected according to the Chamber of Commerce report.

Apart from its tariff provisions the Central American Free Trade Area has the long term objective of encouraging industry in the member countries whose tiny home markets are too small to support manufacturing at present. New industries will have certain tax concessions, especially on the importing of equipment, raw materials and fuel other than petrol. Apart from anything else a great deal of "know-how" will have to be imparted before industrialisation can really get going.

## The True Cost of a Steelworker

Four dollars an hour (29*s*) was the total cost of a United States steel worker in 1959, compared with 94 cents in 1940.

This controversial declaration, which is at odds with US Government data, comes from the annual report of the UNITED STATES STEEL CORPORATION. The figure is arrived at by calculating all the fringe benefits, time off payments and so on, to which the wage earner is entitled.

"Wage rates are completely inadequate as an indicator of the cost of an hour's work," says the report. The $4 figure is almost a third above the official estimate of average hourly earnings by steel industry production workers. The fringe benefits counted in by United Steel do not appear in the US Government's index.

Equally noteworthy is the assertion of the report that 75 per cent of all costs comes from employment cost. There is a familiar ring in the declaration that until general wage inflation is checked nothing can be done in America about checking general price inflation.

The steel company is well placed to put this forward when it is able to calculate that since 1940 steel workers have enjoyed increases equal to 8 per cent compound for each year. Last year there were only small changes both up and down in the prices of United States Steel's products. No significant change in price levels was made.

The 116 day strike brought income down to 7 per cent on sales worth $3,643 million against an income of 8·7 per cent in 1958 on sales of $3,472 million.

US Steel has more than 1,700 people engaged on their research programme, of whom 1,100 are concerned with pure and applied research at its Monroeville research centre, Pennsylvania.

The equivalent of more than £120 million was spent last year on additions to and replacement of facilities, substantially less than the amount, equal to about £160 million, in the year before. The difference was not due to any slowing down in modernisation or expansion but to construction delays due to the strike.

The safety efforts of the company have now lowered the accident figures to 1·05 lost time accidents for every million man hours worked. The rate was 1·10 in 1958 and 1·31 for 1957

## New Twist in Japanese Jackpot

At the end of January the ARABIAN OIL Company struck oil offshore from the Neutral Zone in the Persian Gulf. There are two interesting things about this event. The first is that the company hit the jackpot first time and actually struck oil with its first well. The second is that the Arabian Oil Company is a wholly owned Japanese concern in which some 60 Japanese firms are financially involved. Few of these have anything to do with oil except the MITSUI and MITSUBISHI groups which have substantial holdings, already have some oil interests in Japan. Many of the biggest participants are potentially heavy consumers of oil. They include electricity undertakings, iron and steel, glass, gas, chemical, shipping and shipbuilding concerns. In addition some insurance and commercial interests are involved. The total capital so far subscribed is about £5½ million. Now that oil has been found new drillings will certainly be made in what is clearly a promising area.

For the next few years it looks as though Arabian Oil will have no trouble in selling all its output in Japan. Arabian Oil has a 40 year concession from the Governments of Kuwait and Saudi Arabia separately, each of which has a half interest in the Neutral Zone. An annual rental of $1½ million is payable to each Government plus a rental of $1 million a year on discovery of oil. Annual guaranteed minimum royalties of $2½ million are also payable. Other clauses provide for the building of refineries both in Kuwait and Saudi Arabia when production reaches certain average levels.

The agreement was considered to be on rather stiff terms but its most unusual feature is that it provides for participation by the two governments each of which has the option to buy both 10 per cent of the company's shares and 10 per cent of production for local use at 5 per cent below posted prices.

## Fluidrive in Sugar Beet, in Oil, and in Russia

In ten years the BRITISH SUGAR CORPORATION have cut the time taken to process a ton of beet from 137 man minutes to 37. In the oil industry there is an increasing use of the variable speed fluid coupling to control the flow of centrifugal pumps.

In both connections the FLUIDRIVE ENGINEERING Company is concerned.

The RUSTYFA CONSORTIUM, handling the contract for rubber tyre manufacturing plant for the Soviet Union, has also placed substantial orders with Fluidrive.

Mr. John Perry (inset), the Fluidrive chairman, sets out in his annual

statement to explain why with a 35 per cent increase in sales over the previous year the group trading surplus rose by only £14,379 to £347,042.

It was due to the comparatively high cost of producing some of the newer types of fluid couplings. With growing experience of producing these types, and of the requirements of their users, an improvement in profits this year is expected.

Among the overseas activities of Fluidrive is the recently installed conveyor system of the largest mechanical handling plant in Africa at the open cast pit of N'CHANGA CONSOLIDATED COPPER MINES Limited, Northern Rhodesia. The conveyors add up to more than 4,000 ft and are drive by Fluidrive at a total power of over 5,000 h.p.

In electricity generation, the company is constructing fluid couplings for the CENTRAL ELECTRICITY GENERATING BOARD up to 8,000 h.p. The first three of the 3,000 h.p. Vulcan-Sinclair fluid couplings for the Richard L. Hearn steam station of the HYDRO ELECTRIC POWER COMMISSION OF ONTARIO have been started up.

## Confindustria's Confabulations

The Italian employers' federation, Confindustria, which recently held its annual meeting, is running a campaign to impress on young executives the need for enterprise and leadership in industry. Many young Italians would probably feel that the scope for enterprise on their part is very limited indeed in the bigger companies. Confindustria's reply to this is that of its 80,846 member companies some 73,250 have fewer than 50 employees, only 207 have more than 1,000 employees, while 7,372 have between 50 and 1,000 workers.

The position looks rather different when the total number of workers in a firm is considered. The 207 firms with over 1,000 workers employ 466,850 between them, while some 668,044 are spread rather thinly over the small firms. But whether young men have more chance to be enterprising in big firms or small ones, there is no doubt that they have least chance in the south. The attempts to raise the level of employment in the Italian Mezzogiorno have met with little success. The Government has spent a lot of its own and the World Bank's money on roads, irrigation schemes and other bed-rock investment, but private industry has not found it easy to move in and set up factories.

Confindustria members complain that they are expected to sink their money in new developments without any hope of adequate return, and that in some cases they have to provide the services as well as the factories. Another complaint is that the state-owned IRI and ENI groups get special treatment in the way of taxes and interest rates on loans. These two groups were until recently members of Confindustria, but pressure from the trade unions and elsewhere forced them out. How the conflict between private and public industry develops will now depend on the policies of the new Government. As it is, Confindustria faces the prospect of new anti-trust laws which may not chime at all with its own ideas of what is enterprising in industry.

## Electronics Industry Forms Council

The fast expanding electronics industry now has an ELECTRONICS INDUSTRY COUNCIL. Its constituent bodies will retain full powers over their special fields and the EIC will handle those affairs that affect the whole industry. One of its early functions will be the coordination of statistics.

The industry already has an annual output valued at £200 million a year and this is rising as rapidly as any other United Kingdom industry. Its exports last year were worth about £50 million.

Talks leading to the formation of the new body took place between the ELECTRONIC ENGINEERING ASSOCIATION, the RADIO AND ELECTRONIC COMPONENT MANUFACTURERS FEDERATION and others.

The field EICwill range over includes electronic instruments, sound and television transmitters, radio communication equipment, radar and radio navigational aids, computers, industrial electronic control equipment and industrial television and its components.

The objectives of EIC are:

To promote the wellbeing of the industry in the UK;

To provide a channel for communication with the Government; and

To cooperate with other industrial, commercial and mercantile bodies in the UK and abroad.

The constitution of the new body provides for the affiliation of organisations of firms making electronic components, apparatus and equipment in Britain, except for that used in the broadcast radio and television receiving industry and for public telephone services.

# Controlling Materials in a Distillery

**New plant added to a distillery incorporates a weighing, distribution and control system which is the first of its type to be installed in Scotland.**

A new intake plant, mill room, mash house and tun room have been added to the Ben Nevis Distillery Limited in order to increase the capacity of the plant at Fort William. The plant incorporates a modern weighing, distribution and control system which is the first of its type to be installed in a Scottish distillery. The main contractors for the project, including the steel-framed building housing the plant, were Thomas Robinson and Son Limited of Rochdale.

The installation of the new plant was carried out without any loss of production, despite some site difficulties and the problem of installing a new intake while continuing to handle incoming supplies. This was made possible by detailed planning in the initial stages including, for example, the provision of heavy section beams in various parts of the building to cut down handling problems with the heavy machinery to be installed.

The new plant, which was designed by the main contractors in consultation with the users, includes an integrated conveying system incorporating the use of worms, elevators, and a pneumatic lift. The Robinson Pneu-Spout system was used for all gravity falls. It includes sight glasses at all points where it is necessary to observe the flow of stock.

Although tailor-made to the precise requirements of the distillery, the control system follows the general pattern devised by Robinsons for other recent installations. It includes a central control panel supplied by Elliott Brothers (London) Limited, who also supplied the load cells on which the electrical weighing system is based. The system is sequence controlled to ensure the regular flow of materials throughout the plant, and is designed to reduce the consequences of human error on the part of the operators.

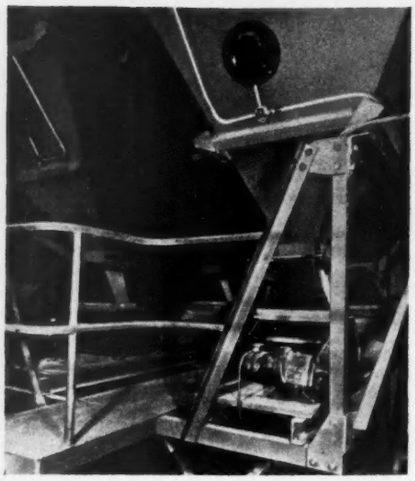
Stock enters the plant via a platform level hopper, which feeds the four 15 ton sheet steel intake bins by means of worms and elevators. Control of the intake is provided by a separate panel installed at the intake point. High and low level indicators are fitted to the bins, the high level indicator being used to operate an audible warning device on the intake panel which can only be switched off at the panel when the operator arrives to change over to another bin. The low level indicators actuate lights on the central control panel which indicate the availability of stock in any of the bins.

From the intake bins, stock is conveyed by feeders, worms and elevators to a precleaner. A selector switch on the central panel enables the operator to select any of the four bins, and by depressing a button on the panel he can then start the appropriate feeder and the worms and elevators to deliver stock to the precleaner.

Five separations are made by the cleaner. It is fully exhausted by a built-in fan to a separate cyclone, the light dust being bagged off with the tailings at a point convenient to an off-loading platform on the floor below. From the cleaner, the stock falls under gravity, via a magnetic separator, to the hammer mill which cracks it to a size which gives a faster rate of water absorption for mashing and cooking. To enable the grinder to work with maximum efficiency on the varying amounts and types of stock, a variable speed motor has been fitted to drive this machine. The speed is controlled from the central panel where a tachometer indicates the number of revolutions. Since it is essential for the variable speed motor to start at the lowest speed, it has been arranged that, should the emergency stop be operated, the pilot motor will bring the brush gear to zero before the flow can be restarted.

Cleaning and milling of the stock having been accomplished, it is now delivered from the mill to either of two weigh bins on the floor above. Delivery is by pneumatic suction lift and then by elevator, the pneumatic suction through the mill serving to clean the screen more rapidly and thus tending to increase the capacity which can be expected from the machine. The pneumatic suction fan and motorised wheel valve at the foot of the cyclone, together with the elevator, are started by a single button on the central panel. A 180 bushel weigh bin and a 60 bushel weigh bin, both mounted on load cells for remote indication of electrical weighing are installed. Choice of bin is made from the central panel where a selector switch operates a motorised dividing valve at the head of the elevator carrying stock from the mill. Movement of the switch also selects the appropriate weight indication dial on the panel.

The 180 bushel weigh bin feeds stock by gravity to the cookers. There are two steam pressure cookers, each having a capacity of 90 bushels, and procedure is to fill one while the other is cooking. The resultant gluten from both cookers is delivered by a common pump to a mashing machine and thence to the mash tun. Stock from the 60 bushel bin is gravity fed direct to the mashing machine. A high level indicator on each of the weigh bins cuts out the motor of the intake bin feeder in operation at the time, and operates an indicator light on the control panel to show that milling is completed and that cooking and mashing can begin.

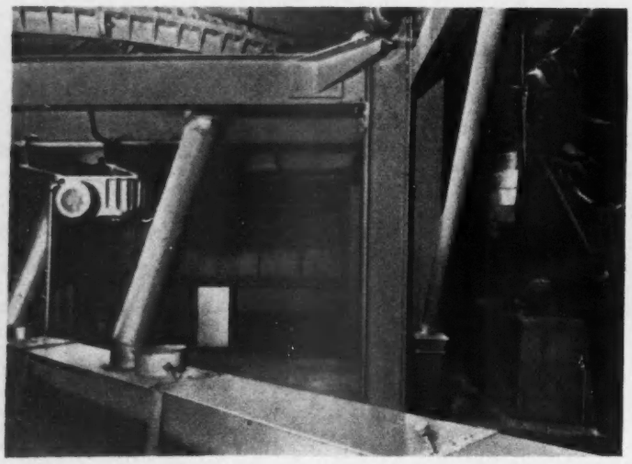


*Feeders fitted to the intake bins are controlled from a central control panel. The diaphragm type indicators fitted to the bins actuate lights on the panels which show the availability of stock.*

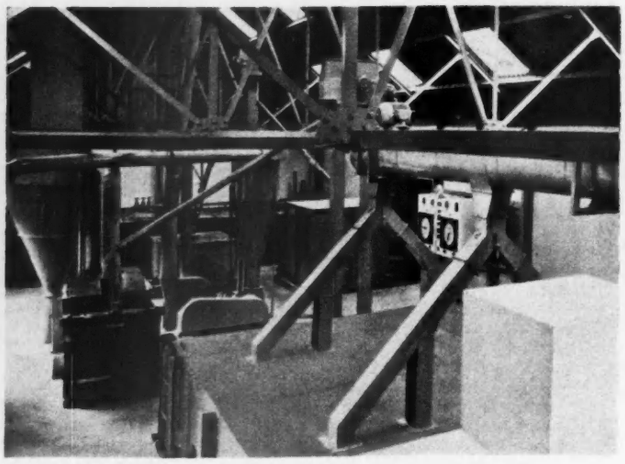
Two 5,000 gallon insulated hot liquor tanks heated from the plant's main boiler, supply hot water to the sparger fitted to the mash tun. They also supply hot water for washing down.

The wort is drawn off from the mash tun through a wort regulator to the 2,000 gallon capacity underback situated below. It then travels via a plate type cooler to the washbacks for fermentation. Eight washbacks have been provided, each with a capacity of 5,000 gallons. They are to the user's own specification and are of concrete construction, the interior surfaces being sprayed with neoprene.

The mash tun, which has a capacity of 30 quarters, has rake arms fitted to the rumaging gear which divert the draff to two outlets in the base. The draff then falls by gravity to a conveyor which feeds at lorry height in a bay adjacent to the intake bay.



*The worm in the foreground takes away the draff which falls from the mash tun above. The underback can be seen in the background.*



*A general view of the installation. The central control panel can be seen in the background with the 180 bushel weigh bin on its left.*

## Machining Beryllium

Britain's first large-scale plant for machining beryllium was opened in Coventry recently by Sir W. G. Armstrong Whitworth Aircraft Limited, a member of the Hawker Siddeley Group. It will be used for producing beryllium components for nuclear reactors.

Beryllium is a light metal which, due to the extreme difficulty in extracting the metal from the ore and then refining it, has been available only in small amounts since 1945. It has come into prominence recently because of its application to nuclear power. It is to be used as a canning material for fuel elements in the new advanced gas-cooled reactor which the United Kingdom Atomic Energy Authority is building at Windscale. The metal will operate at temperatures higher than those in the reactor at Calder Hall.

The metal has disadvantages to general use in industry. Firstly, it is quite expensive; secondly it is very brittle. Also, although the metal itself is not dangerous, there are hazards associated with beryllium when it is in the form of fine dust.

The new factory contains pressure "shells" which are supplied with filtered and heated air which is changed every three minutes. All machining processes are carried out inside completely enclosed machines, provided with their own high speed extraction systems, and any air leaving these contact areas passes through

*A totally enclosed lathe for machining beryllium.*

an elaborate system of filters and is purified before being allowed to escape to atmosphere up a 120 ft high chimney.

If beryllium proves to be satisfactory in the Windscale reactor, and seems to be an economic proposition, there is no doubt that there will be a great increase in the demand for machining this metal for components in nuclear power engineering.

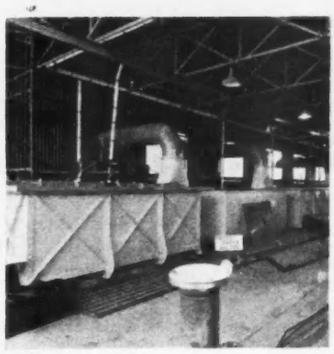
## International Automatic Control Congress

The British Conference on Automation and Computation, in the role of the British member body of the International Federation of Automatic Control, has selected 28 papers over the last year which will form the British contribution at the first International Congress on Automatic Control to be held in Moscow from 27 June to 7 July. The arrangements for this meeting are being undertaken for IFAC by the USSR national committee for automatic control. A total of 282 papers will be presented at the congress by representatives of 20 countries.

There will be an official British delegation which will be led by Mr. J. F. Coales, of the University of Cambridge. Applications for the limited number of places at the congress should be sent as soon as possible to the Honorary Secretary, Group A, BCAC, c/o The Institution of Mechanical Engineers, 1 Birdcage Walk, London, SW1. The estimated cost of the trip is £200 a head.

## Pvc for Acid Degreasing Unit

The accompanying illustration shows the latest of the Turbro range of chemical plant and equipment. It is a complete acid degreasing unit comprising 20 ft long heated acid tanks, rim fume extraction, fans, ducting, pipework, wash tanks, soap and creosol tanks. The equipment



*Pvc is the main constructional material for this degreasing plant.*

was designed, manufactured and installed by Turner and Brown Limited of Bolton to the instructions of the Ministry of Works for use at a Government research base.

It is of particular interest since the majority of the equipment including the acid tanks are manufactured from Cobex rigid pvc, reinforced with glass fibre. The plant is primarily used for the degreasing of fabricated stainless steel pipes and fittings.

## Selenium Rectifier Production in India

Despite the increasing use of silicon and germanium power rectifiers, the demand for selenium rectifiers continues to expand both in Britain and overseas. This is borne out by the fact that a complete plant for the manufacture of Westalite selenium rectifier elements has been designed and manufactured in the Chippenham Works of Westinghouse Brake and Signal Company Limited, and shipped in one consignment to India. The design, manufacture and shipment of the plant was effected in eight months. The plant is for Hind Rectifiers Pvt. Limited, a subsidiary company of Kaycee Industries Limited of Bombay, who have been licensees in India of Westinghouse rectifiers and associated equipment since 1946.

Personnel from the Indian company have been trained at the Chippenham Works of Westinghouse in the manufacturing processes and techniques used in producing the rectifiers, and they also personally inspected and tested all the new equipment prior to packing for dispatch.

## Variety-Reduction Seminar

The need for accurate costing of engineering products, particularly with increasing competition in domestic and overseas markets, was emphasised during a two-day seminar held in Birmingham recently. The seminar, dealing with variety reduction, was organised by the Birmingham Productivity Association and the British Productivity Council.

Speakers at the seminar suggested that manufacturers should examine and strengthen their costing systems to make them more effective in providing costings for individual product lines to indicate profitability. It was emphasised that proper control of variety could reduce complexity at all stages of production, and reduce cost, raise total profits and make it possible to keep prices attractive to the customer.

Periodic analysis of sales records was advocated to focus attention on those lines which were not selling well or which were unprofitable. Steps could thus be taken to reduce cost of manufacture or to substitute another article in the sales list. The advantages of work study for improving layouts, methods, work flow, productivity and quality were also discussed.

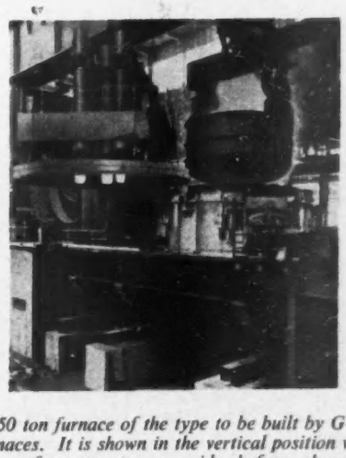
Two of the leaders of the seminar, Mr. R. M. Sumpner and Mr. J. D. Miller, of Associated Industrial Consultants Limited, pointed out that more competitive prices and better delivery could be expected as the result of applying variety reduction techniques aimed at achieving maximum total profits, and these features could help toward a more positive approach to selling.

## Britain's largest Electric Arc Furnace

Following the recent statement of the United Steel Companies Limited, that they are to spend £10 million installing what will be the largest electric steelmaking plant in the world at their Steel, Peech and Tozer branch, GWB Furnaces Limited, of Dudley, have announced that they are to supply the first two electric arc furnaces for the project. The furnaces will be almost twice as large as any previously built in Great Britain, and their electrical demand will be 40 MVA each—much the same as the town of Huddersfield.

The furnaces will be of Demag design; although, apart from the regulator, the equivalent of which is unobtainable in this country, the units will be entirely of British manufacture.

Each furnace shell will have an internal diameter of 24 ft, a nominal capacity of 150 tons, and will be capable of melting at the rate of 1 ton per minute. In practice, the furnaces will be used for a maximum of 110 tons ingot weight. Construction of the furnaces will follow the Demag king pin or gantry design in which the roof is the only item lifted from the shell when top charging takes place. The weight of the electrode equipment is permanently carried by the gantry which, after raising the roof, swings



*A 150 ton furnace of the type to be built by GWB Furnaces. It is shown in the vertical position with the roof swung to one side before charging.*

aside for furnace charging around a king post. Roof raising is done hydraulically, and the gantry is swung aside by an electric motor driving through gears. Shell and gantry are mounted on a platform which is supported by three rockers which allow the furnace to tilt forward through 45° for pouring and 15° backwards for slagging.

# An Instant Mix by Plugging in a Plug

**Graded stone at Cliffe Hill quarry is batched automatically to standard formulae by a plug-in control system. Manual control allows non-standard mixes to be prepared.**

At the Markfield quarry, near Leicester, of the Cliffe Hill Granite Company Limited, some 1,400 tons of stone are quarried and processed daily into such products as tar macadam, ready-mixed concrete, road chippings, aggregate, railway ballast and filter media. To meet the requirements of the tar macadam and concrete plants, and of various customers, it is necessary to mix the graded stone according to a number of formulae. All standard formulae are now mixed by a fully automatic plant installed by the Ensign Conveyor Company Limited, Nottingham, the Materials Handling Division of Thos. W. Ward Limited. Non-standard formulae can be prepared by manual control, using setting dials and push buttons.

After blasting from the quarry face the stone is taken by diesel dumpers to a primary crusher on the intermediate level of the quarry and there reduced to −6 in. It is then lifted by a 500 ft belt conveyor rising 150 ft to a 100 ton hopper and a live-roll grizzly, where dirt and $-1\frac{1}{2}$ in stone are removed. A 300 ton hopper receives the clean stone and passes it to a secondary crusher, followed by a selector screen unit, which produces four sizes: $-\frac{3}{8}$ in, $-\frac{3}{4}$ in, $-1\frac{1}{2}$ in and −2 in; oversize is recirculated through the crusher. The four sized products pass to separate bins, each of 100 tons capacity, and thence to tertiary crushers or direct to the final screens.

The final screens are on top of the storage bin building, which was the first part of the new plant to be installed by Thos. W. Ward. Stone arriving at this point first passes a scalping screen which separates the feed into $+\frac{3}{4}$ in and $-\frac{3}{4}$ in, the $+\frac{3}{4}$ in material passing to a second screen, with four products, 1 in, $1\frac{1}{4}$ in, $1\frac{1}{2}$ in and 2 in, each product falling by gravity to the appropriate bin below. Material of $-\frac{3}{4}$ in passes over two screens, giving a further four products, dust, $\frac{1}{4}$ in, $\frac{3}{8}$ in and $\frac{1}{2}$ in, the stone being discharged to the bins below in the same way as from the previous screen. In all, there are 11 bins, seven of 300 tons and four of 150 tons capacity. Pneumatically operated gates enable road vehicles to be loaded direct with any grade of stone.

This storage installation is the basis of the second part of the complete scheme, which enables the plant to carry out any one of four main duties. By means of conveyor equipment installed by the Ensign Conveyor Company, and controls supplied by Ericsson Telephones Limited, Nottingham, the plant can either: deliver batches of material to an existing tar macadam plant; load batched materials into lorries; deliver batched or graded materials to a ready-mixed concrete plant; or load them to a conveyor taking them to a stocking area.

Each of the bins in the storage building is fitted with an "Accrabatch" constant-rate volumetric feeder, discharging to a conveyor extending beneath the complete line of bins. This conveyor is reversible, to discharge at one end for immediate use, and at the other end for stocking. The feeders are set to deliver at a rate of 120 tons per hour each, and the feed is controlled from a central control room, on a time basis.

From the Ericsson control console, which is housed in a separate building near the storage bins, control is exercised over the 11 constant rate feed systems, and material can be metered out by means of timers controlling the feed motor contactors. Materials fed to the conveyor go forward to a second conveyor which discharges, through a 12-position indexing chute, to an eight-compartment silo. This holds a group of batches of predetermined composition ready for disposal. Eight of the indexing chute positions correspond with the eight silo compartments, the ninth feeds via a conveyor to the ready-mixed concrete plant, and the tenth feeds direct to a lorry loading position via a by-pass chute. The eleventh and twelfth positions are held as spares. All the eight compartments in the silo, each of which holds 2 tons, are used for feeding the tar macadam plant.

If material is to be delivered to the ready-mixed concrete plant or to the lorry loading position, the indexing chute is directed, by means of a switch on the control console, to the ninth or tenth position respectively. Otherwise, the chute selects automatically the first empty silo compartment.

Setting dials enable the proportion of each grade of material metered from the hoppers to be selected manually; thus a mix of up to 2 tons can be made of any or all of the 11 grades stored. To enable a check to be made of the total quantity called up in such a manual operation, a totaliser is fitted.

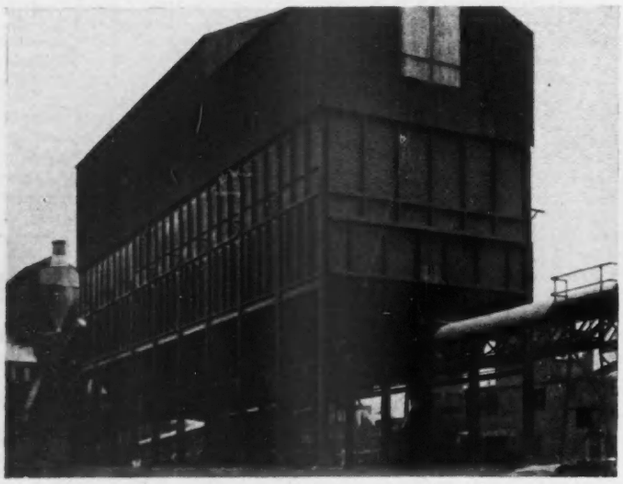
Most of the requirements are, however, for standard batches, which are made up to prepared formulae. These are given a number, and all that is necessary when a standard mix is required is to insert a numbered formula plug and the console takes charge automatically. Each formula plug is internally wired to give instructions to the system, covering: formula number, time of entry of this number into a corresponding indicating store, and time of completion of the batching operation.

At the main control console the formula number representing a batch is displayed on Digitron number-indicating tubes in a position showing into which silo the batch has been delivered. This information is duplicated on a slave panel in the tar macadam plant. As the silos are emptied by the tar macadam plant operator to suit the running of that plant, the signals giving the formula in each silo on both the main control console and the slave unit are cancelled automatically, and batching can be re-started as required, with the same formula or, by changing the plug, with a different one. A limitation of 48 formulae exists in the equipment.

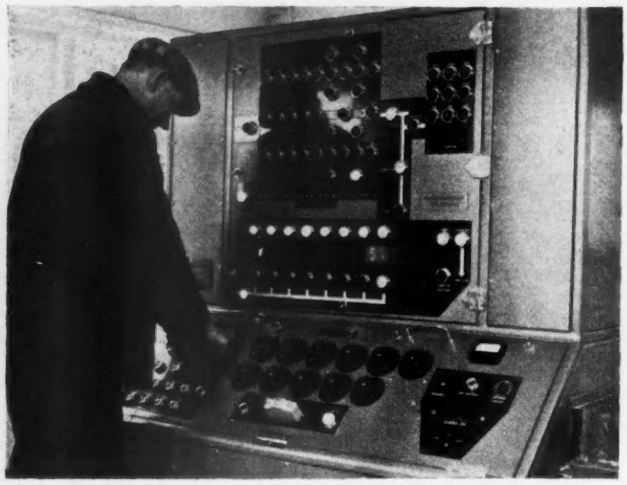
Normally only one batch is delivered, but by pressing a separate button, any number up to 10 can be passed through automatically. Provision is made to give the operator an indication of the total weight of materials set up during a manual/repeat batch operation. In such a case the operator sets up a desired weight and adjusts the number of batches until the indicator shows that this weight will be delivered. Thereafter, the control system operates automatically until the required total weight has been delivered.

A separate formula plug is provided to permit delivery of a batch of 2 tons of any selected one of the eleven grades. To this the formula number 99 is allocated, as a means of identification, and this number appears on both indicator panels. The same number is used to indicate a manually made up mix. In both cases the number 99 simply indicates a non-standard formula.

Feed indicator lights are provided for each of the 11 storage bins, and high and low bin levels are indicated in the same way. Interlocking prevents operation of the system unless the relevant conveyors are running, an empty storage bin exists, or the swivel chute is set to "lorry" or "diverter" (ready-mixed concrete plant) position, and a formula plug is in position. For manual control a "manual" plug is inserted. A mimic display panel on the main control console shows the operation of the system.



*Eleven grades of stone, held in this storage building, can be drawn off in any required proportion, either manually or automatically.*



*"Formula" plugs are inserted in the control console to give automatic batching. A plug is in position below the eleven setting dials at the bottom.*

# Safe Channels for Supertankers

Oil tankers have developed to such a size in recent years that sea-bed wrecks, formerly deep enough to be ignored, are now a potential hazard to navigation in some coastal areas. For this reason the Hydrographic Department of the Royal Navy is re-surveying part of one of the busiest shipping routes in the world, the English Channel. After the war, naval survey ships charted wrecks around the British coast, and those in important channels likely to be a danger to shipping were depth charged to give a clearance of at least 45 ft at low water. This work was done by the RN wreck dispersal fleet, and hundreds of wrecks were effectively buried or broken up. The wreck dispersal fleet was disbanded in 1958, and since that time dispersal of dangerous wrecks has been, in the majority of cases, the responsibility of Trinity House.

With the increased draught of tankers it is now considered that there should be at least 60 ft of water over wrecks in or near important channels, and the first step is to locate and pinpoint accurately on the charts all the wrecks which might be dangerous.

A start has been made by HMS Scott, a survey ship based on Dover, in a busy area stretching south-westwards from the North Goodwins lightship to a point some twelve miles south of Dungeness lighthouse, and including the Varne shoal. There are some fifty to sixty wrecks in this area, and the positions and depths of some of them may have changed since the last survey. HMS Scott, which will be engaged for about three months in the area, is carrying out the first systematic survey of this part of the channel using modern echo sounding equipment. The latest Asdic equipment will ensure that the positions of the wrecks are accurately fixed on the charts, and, by Oropesa and drift sweeps, the clearance above the wrecks will be measured and recorded. Wreck surveying is not the only hydrographic work necessitated by the use of supertankers. These large vessels will be using ports where previously the ships have been much smaller, and accurate surveys of these areas are needed. At Milford Haven, for example, where supertankers will berth at the new oil installation, an area has had to be sounded out ready for the ships when trading starts.

This little-publicised work of the Navy—the preparation and correction of navigational charts—is a never-ending task. Apart from changing navigational needs caused by shipping developments, of which the increase in tanker size is a good example, there are still many parts of the world which are inadequately charted. Three thousand or more charts cover, on various scales, virtually all the navigable waters in the world, but hundreds of reports of actual or alleged inaccuracies are received by the Admiralty hydrographer every year, and all of them have to be investigated.

Apart from wrecks, which may change their positions and depths as a result of underwater currents, currents themselves change direction, and so cause movement of natural navigational hazards. The classic example of a continually changing hazard is, of course, the Goodwin Sands, which, if surveys over the last hundred years or so are plotted, are seen to be making a very slow anti-clockwise rotation. This area is also receiving attention. HMS Echo, an inshore survey craft of the Navy, will be based on Ramsgate during the summer and will complete work on the Goodwins survey started last season.

Other survey ships, large and small, are based in different parts of the world, and their work is recorded and coordinated in the Admiralty Hydrographic Department at Cricklewood. A large modern printing works at Taunton produces the charts, of which over a million were sold last year, to shipowners of all nations.

# Powder Cutting Solves a Mining Problem

Modernisation of one of the shafts of Merthyr Vale colliery, South Wales, involved the removal of the old cast iron cage guides which, in one part of the 1,400 ft shaft, were integral with the cast iron tubing used to pass the sinking through a quicksand stratum. Unsuccessful attempts were made to remove the guides by conventional methods, and it was decided to try powder cutting equipment. Volunteers from British Oxygen Gases Limited undertook to operate the equipment, and permission was obtained from the Mines Inspectorate to use a naked flame underground. The obstructing guides which had to be removed were continuous cast iron projections 96 ft long and 4 in thick, and were at a depth of between 400 and 500 ft.

A shaft cage, with a temporary platform bolted on the top, was used for access to the working position, and to carry the equipment. Safety harness was worn by the workers.

Owing to construction work at the pit head, where the cage would normally be loaded, all movements of men and materials had to be made from a fan inset 30 ft below the surface. Here, the fan draught was sufficient to suck iron powder from the top of the dispenser; consequently, charging of the dispenser had to be carried out at the working position. Working during two consecutive week-ends—a total of 31 cutting hours—the team removed the guides successfully without interference with colliery output. The equipment consisted of a " Saffire " heavy-duty oxy-acetylene powder cutting outfit, three cylinders of oxygen in manifold, two coupled nitrogen cylinders, one cylinder of dissolved acetylene, and a powder dispenser.

*Nearly 100 ft of cast iron guide rails were removed by powder cutting, 400 ft below ground, at Merthyr Vale colliery.*

# More Protection for Ships' Bottoms

A new approach has been made into anti-fouling systems for ships by Charlton, Weddle and Company Limited of Newcastle upon Tyne. They have developed the ANFO method. This system can be controlled from any point in the ship, and is operated only when it is needed. That is, when the ship is in port, at anchor or stopped near the coast.

The ANFO system uses toxin CW60B, which will destroy or deter all species of fouling organisms. The toxin is distributed over the whole of the underwater surface of the hull through a piping system, with atomising nozzles at suitable intervals. An air compressor, injector pump, gravity feed tank and control panel are mounted in the ship, and when anti-fouling protection is needed, the equipment is set in operation. Toxin CW60B, in liquid form with kerosine as a carrying agent, is distributed through the piping, which is of small-bore high-impact pvc. Emission from the tubes is in the form of bubbles, which disperse over the surface of the underwater hull, collapse and deposit a film which is lethal to fouling organisms. A year's supply of toxin can be carried in a relatively small storage tank.

In addition to being available for ships in normal service, the ANFO system can be adapted for laid-up vessels, or warships held in reserve. In this case the emission tubes can be fitted permanently to the ship and the operating machinery mounted ashore, connection being by flexible tubing. Alternatively, if several ships are involved, they can be moored over a portable grid of piping with the operating machinery ashore.

External hull cathodic protection can be fitted without affecting the successful operation of the system which, it is claimed, will keep a ship's hull free from fouling and corrosion so that it can be operated for a minimum of 18 months without the necessity for dry docking for hull maintenance.

Fouling of ships' hulls by marine organisms is a problem as old as ships. It increases the frictional resistance of the hull, accelerates corrosion, and interferes with the operation of sonic sounding devices by causing reflection and scatter. Fouling organisms are confined to narrow coastal belts and harbour precincts, and cannot attach themselves to a ship's hull when the relative velocity of hull and water exceeds about one knot. But once the organisms are attached, they remain, and the only sure way to get them off is by scraping, which is done when the ship is dry docked for routine maintenance purposes. Hull fouling, however, can reach troublesome proportions long before a normal dry docking is due.

The toxic effect of copper on the fouling organisms has been known for centuries—there is some evidence that copper sheathing was tried as long ago as 800 B.C.—but it was not until the 18th Century that copper sheathing really began to be used effectively.

Copper sheathing, though a solution to the problem of fouling on wooden ships, became impracticable as soon as iron hulls were built, because of the electrolytic action of the two metals. It was tried, but with disastrous results. Today, it is obviously too costly to sheath a large ship with copper, even if the electrolytic problem were overcome.

Anti-fouling paints are the common method of combating the attachment and growth of the fouling organisms. These paints contain a substance which is toxic to the marine organisms, and which passes into the water at the paint/water interface. The toxic substance is liberated continually as long as the hull is in the water, but it is really only needed while the ship is in port or stationary near land. The ship is naturally immune from fouling as long as it is travelling in deep water.

# On the Shelf

*By Frank H. Smith*

For what, one wonders, do some librarians get paid? On what basis are they chosen? And, finally, what is the good of knowing the UDC by heart if you do not know where to find the stuff? All this indignation arises from a Recent Experience. A request came to me from the National Central Library on which I was the ninth "hope." The previous eight had all put "Not in Stock." The subject was not in my field, either. It took me just 15 minutes and three telephone calls to trace the work, which had been originally requested in November last. The originating library, with a staff into which mine could be put several times over, could just as easily have done what I did and had the book the following day. This is not written in any spirit of "aren't I b—— clever," I can assure you. I just cannot understand the slack spirit of "let the other fellow do it" that pervades some libraries.

City of Nottingham Public Libraries' chief—F. C. Tighe—has kindly sent along their specialised book list on electrical engineering. This is divided up to make it easy, into such subject headings as Periodicals; Abstracts; Dictionaries; and so on through General to an alphabetised list of subject headings starting with A.C. and D.C. and ending with Transformers, Rectifiers and Converters. With this list was their February *Technical Periodicals Review*, which lists interesting titles from some 55 journals and has an insert giving a bibliography on "The Outer Seven."

I've not seen it before so perhaps there are others as ignorant. *Documentare Technica*, Volume 12, No. 1, for January 1960, has come to me from Institutul de documentare Technica, Bucuresti, Raionul Stalin, Str. Kuibisev nr 27-29. It has a five-language index to 12 subject-headings and though it is No. 1 of the volume, the pages run from 2967 to 3158. Each abstract is decimal classified so that even if you cannot understand a word you know what you might have read if you could have of. The titles of the abstracts are given in Bucurestian with the language of origin in brackets.

A firm called American Exporter Publications (386 Fourth Avenue, New York 16) believe in plenty of notice. In October, 1960, they will begin publication (does that mean we get it then?) of *International Electronics* (and its Spanish counterpart *Electronica Internacional*). "Qualified firms will receive the publication free of charge." Another of these awful controlled circulation jobs with questionnaires attached, I suppose.

The most comprehensive directory (it says) of university extensions, correspondence schools and testing centres, covering many hundreds of institutions in 42 different countries—*Worldwide Register of Adult Education* at $5·98 (why not 6?) from Aurea Publications, Central Valley, New York. Then there's some bit about if you apply now for a preview copy it's only $3·78.

Dawson (16 West Street, Farnham, Surrey) now do a 1960 list of their reprints of journals and of others which they will obtain for you. The list is called "Scientific Publications."

Publishers are making their spring catalogues so attractive that they deserve a place on the bookshelf alongside the books they list. Jonathan Cape (30 Bedford Square, London, WC1) have a weird but colourful bird with a tulip-shaped rose in its beak, flying across the top of the cover with the Cape house-symbol tattooed on its wing. Longmans Green (6-7 Clifford Street, London W1) have a venational leaf, fairly stark. Both have mouth-watering titles in them but neither has anything technical enough to justify my mentioning it. That does not stop you from getting your own copy.

# Insuring Against Nuclear Hazards

**Indemnification of Atomic Energy Activities and Operations of Advisory Committee on Reactor Safeguards.** Report to the Joint Committee on Atomic Energy on Operations, 1958-59. Parts 1-4. *United States Atomic Energy Commission, Washington 25, DC, USA.*

Section 170 of the United States Atomic Energy Act, 1954, as amended constitutes the major part of the Anderson-Price legislation which was enacted in September, 1957. This was designed to deal with the problem which in this country was one of the objects of the recent Nuclear Installations (Licensing and Insurance) Act, 1959, that is to say, the insurance or other financial cover to provide compensation for persons sustaining injuries or damage to property arising from the large scale production and use of atomic energy. This matter is currently the subject of three draft international conventions under discussion by OEEC, Euratom and the International Atomic Energy Agency.

In the United States, the Anderson-Price Act placed two responsibilities on the US Atomic Energy Commission. First, as part of their duties when licensing the construction and operation of nuclear reactors or other large-scale facilities, the Commission are required (with one exception) to determine the amount of insurance cover which each licensee has to take out from private sources of insurance. This determination is based on the Commission's criteria which take into account the cost and terms of private insurance available, the type, size and location of the licensee's plant and the nature and purpose of the licensed activity. The exception is that the operator of an electricity reactor with a rating of 100 megawatts or over is required to take out cover for the "maximum amount available from private sources" which stands at present at $60,000,000.

The second duty of the Commission is to indemnify the licensee "and other persons indemnified, as their interest may appear" from third party liability for the astronomic amount of $500,000,000 above the amount of cover from private sources.

The Commission's report is the first of the annual reports to be made to the Joint Committee on Atomic Energy in compliance with the provisions of subsection (i) of section 170. It covers the period January 1958 to March 1959. It is in five parts. The first part deals with the indemnification of licensees and in the main is concerned with the problems of the "gaps," that is to say, the cases which could arise where the private insurance cover available is, for one reason or another, less than the full amount for which the licensee is required to insure and accordingly the Commission's indemnity has not yet begun to operate. Gaps may arise from a defect or awkwardness in the terms of the private insurance policy such as the fact that the policy does not cover the consignments of, say, nuclear fuel to a licensee from a privately owned, as opposed to a Government owned, plant; this can of course be met by amending the form of the policy.

But a more intractable "gap" could arise where the original private insurance cover has been partly exhausted by some prior accident. This raises the issue, which the draft international conventions are facing, whether insurance is to be "per incident," which the administrators all want for its neatness, or "per installation," which the insurance companies, not unnaturally, insist on, as their resources would not be equal to the strain of two accidents in quick succession, each of which involved liabilities approaching the full amount of the cover. In the recent Act in this country, Parliament has decided in favour of insurance "per installation" for the fixed cover of £5 million which will apply to all reactors regardless of their heat or power output, the premium being related to the insurance market's view of the financial hazards which each installation presents. If the £5 million cover has been reduced unduly by small claims (and more especially by a single large accident) the Minister can require fresh insurance to be taken out for the full £5 million; and if there should be insufficient insurance moneys to compensate all the victims in full, Parliament will be invited to supply the funds out of which alone the licensee is required to pay the excess.

In the USA the Commission suggest that the legislation should be amended to authorise the Commission to fill this gap for a reasonable period so as to enable the licensee to make suitable arrangements to restore the full amount of the original cover.

Other kinds of gap could arise where there is a "common occurrence," for example a polluted river where the radioactive pollution is attributable to two or more licensed facilities, and the different licensees have different amounts of cover required by their respective licences; or where the policy covers only claims which are presented within two years after the end of the policy period; or where the policy is suspended by the insurers because the licensee fails to comply with a request to correct some unduly dangerous condition; this last gap seems an unusually intractable one, which can only be prevented by good sense on the part of both insurers or insured.

The report discloses that of the 13 non-exempt reactors, 12 are insured. The owner of the thirteenth is relying on his own financial resources. The minimum financial protection ($250,000) is required for 11; the licensees of the other two are required to have protection at the rate of $150,000 per megawatt. Seventeen educational institutions are exempt or eligible for exemption, although seven have taken out insurance.

It is comforting, but not at all surprising, that the Commission announce that no claims have been made against their indemnity. The simple fact must be faced, that the atomic energy industry must demonstrate its safety during the next few years. A single disaster could put back the clock for twenty years or more.

In part 2 of the report, the Commission disclose that they have made indemnity agreements in 33 cases, covering most of the Commission's installations operated by contractors and including the Railroad Associations in respect of nuclear incidents arising in the course of transport of materials for the Commission.

Part 3 is concerned with maritime indemnity problems and foreshadows the international convention which is required for this subject. Part 4 touches on the problem of foreign third-party liability, which the three draft conventions are dealing with. It mentions with approval the essay published by the Harvard Law School and Atomic Industrial Forum entitled "Financial Protection against Atomic Hazards: The International Aspects," which is indeed a valuable contribution to this somewhat tortuous line of country.

C. J. HIGHTON

**Indemnification of Atomic Energy Activities and Operations of Advisory Committee on Reactor Safeguards.** Part 5: Operations of Advisory Committee on Reactor Safeguards.

The report covers the period January, 1958, to March, 1959. It is a factual record, listing the main projects reviewed by the Advisory Committee during that period. Copies of formal letters from the chairman of the Advisory Committee to the chairman of the United States Atomic Energy Commission are presented in appendices. These letters represent the formal view of the committee on the projects under consideration and normally conclude that the reactor can "be operated with an acceptable degree of risk to the health and safety of the public." The correspondence occasionally indicates points on which the committee require further information and/or limitations on the experimental programme planned for the reactor. But both the main text and the appendices are

written in a summary form, and in such an abbreviated manner than the reader cannot appreciate the safety issues involved. Indeed, it would be a formidable task in a summary of this type, as on each project it is clear that a very large number of supporting documents have been presented to the committee and discussed at length in the various committee sessions. The text merely stands as an interesting historical record of the projects considered, with committee recommendations.

The bare facts contained in the report are shown up in greater relief in the report of the hearings before the Joint Committee on Atomic Energy. The Joint Committee heard evidence from a large number of witnesses on matters of indemnification and reactor safety in its hearings on 29 and 30 April, 1959. These hearings, taken together with the report under review, present an extremely interesting account of the structure of the Advisory Committee on Reactor Safeguards and the way in which it conducted its activities during 1958-1959.

The Advisory Committee, appointed by the Atomic Energy Commission, has a maximum of 15 members, and 12 members were serving during the period reviewed. It has representation from acknowledged experts in the skills of chemistry; chemical, mechanical and sanitary engineering; environmental hygiene, metallurgy, physics and reactor operation. All members of the committee hold positions independent of the Atomic Energy Commission and can therefore only give a limited amount of time to the work of the Advisory Committee.

In the period under review the committee held eleven meetings, each of two to three days' duration. The committee reviewed and gave advice to the Commission on eighteen projects, including information on the military programme; and, in addition, gave preliminary consideration to a further 17 projects.

Each committee member receives hazard summary reports written by contractors or applicants, before meeting collectively. At the committee meetings, the permanent staff of the Commission present an analysis of the key safety factors related to the specific cases under consideration. After briefing by the staff, the committee may then hear a formal presentation from the applicants on major safety problems. The committee then discuss the matter collectively and formulate an opinion which may in some cases require further study to be undertaken on the part of the applicant or the permanent Commission. The committee finally present their recommendations in a letter to the chairman, as illustrated by the letters in the appendices.

F. R. FARMER.

# Plasma Confined

**Proceedings of the Second International Conference on the Peaceful Uses of Atomic Energy.** Vol. 31: Theoretical and Experimental Aspects of Controlled Fusion. Vol. 32: Controlled Fusion Devices. *United Nations, New York, USA; HMSO, London.* (Each volume 126*s*)

For those connected with research on controlled thermonuclear reactions these two volumes are of very special importance. It was at the time of this conference that the major powers declassified their work in this field. As a result, the hundred or so papers presented on this subject and contained in these two volumes revealed for the first time the results of some seven or eight years research in the case of the USA, the USSR, and the United Kingdom, and the results of shorter and more limited research programmes in the case of several other countries. These volumes will be the most important reference books on this subject for some time.

Volume 31 contains firstly general reviews of the subject given by leading scientists from each country; secondly 33 theoretical papers; and lastly a few of the experimental papers. The other volume is devoted entirely to experimental papers. Although some of the review papers will be of interest to the general technical reader, the majority of the papers are written for the specialist. The non-specialist who is interested in acquiring background knowledge in this field is referred to the much more suitable book *Project Sherwood*, by Amasa Bishop which is reviewed below.

Among the papers are descriptions of all the ingenious electromagnetic field configurations which have been thought up to contain hot ionised gas, the method by which the gas can be heated, and the results obtained so far with these devices. Extensive reviews of this work have already been given in ENGINEERING (vol. 186, 1958, pp. 796 and 824). The state of the research can be judged by the fact that, although nuclear fusion reactions have been induced in several experiments, only in one case (see below) was it suggested that the reactions were caused by a high temperature and not by the spurious acceleration of a few particles. To get a detectable thermonuclear reaction a temperature of several million degrees is needed; to get useful power from such reactions the temperatures must be raised by a further factor of fifty or more and be maintained for much longer times. The workers in this field have a long road ahead of them.

To those people who acquired reprints of the papers at the time of the conference, it is important to point out that the text of these papers had to be submitted four months before the actual conference—a long time in fusion research. Several contributors took the opportunity to report important last minute results in addenda at the time of the conference. These additions are found in print for the first time in these two volumes. Outstanding among these are (1) the results showing no energy shift in the neutrons from the apparatus Scylla at Los Alamos (so that J. L. Tuck was able to claim, as he still does, a possible thermonuclear reaction), (2) similar discharges obtained by Kolb at Washington, (3) the energy loss measurements on the toroidal pinched discharge by Colgate and others at Livermore and (4) the detection of a Doppler shift with the toroidal pinch Sceptre at the AEI Research Laboratory at Aldermaston Court, Aldermaston.

**Project Sherwood: The U.S. Program in Controlled Fusion.** By AMASA S. BISHOP. Prepared for the United States Atomic Energy Commission. *Addison-Wesley Publishing Company, Inc., Reading, Mass;* and *London* (44*s*)

Project Sherwood is the name given to the United States Atomic Energy Commission's programme of research aimed at producing useful power from controlled thermonuclear reactions. This account of the project—from its inception in 1951 up to 1958—can be regarded as an official history of the project, not only since Amasa Bishop was from 1953 to 1956 chief of the AEC branch responsible for administering this research, but also because it was written in "working hours" while Bishop held another appointment with the AEC. The book has been written so that it can be followed by readers with little technical background and the clear and easily readable text is supplemented by a wealth of simple and attractive diagrams.

The first two chapters explain the basic physics of the hydrogen fusion reactions and give the very high temperatures and other conditions which must be attained if ever useful energy is to be generated by such reactions. Subsequent chapters explain the various devices which have been thought up to achieve these ends. They include a variety of electromagnetic field configurations to contain the hot ionised gas, and combined with these are several methods of heating the gas. In the days of secrecy the American scientists independently thought of all the ingenious configurations devised by United Kingdom and Russian workers and a few more besides.

Problems have been met in all the methods of approach which have left the drawing board. Outstanding among these is the fact that a hot gas confined by a magnetic field is often unstable.

Unlike the UK Atomic Energy Authority, the AEC has no laboratories of its own—all the research is done by universities or private industry under contract to the AEC. The four main centres for Sherwood research are the Los Alamos Laboratory (New Mexico) and the Livermore Laboratory (California) both run by the University of California, the Oak Ridge National Laboratory (Tennessee), run by the Union Carbide Company, and lastly Princeton University (New Jersey). The project started in a small way in 1951, a date several years after the UK started in this field, and then expanded rapidly. The present scale of effect—annual budget $30 million—is well above that of the UK and USSR programmes.

This book is highly recommended to both the general reader seeking a clear survey of the field and also to the specialist. The latter is unlikely to have had time to read all the 70 papers on US fusion research presented at the Geneva Conference in 1958 and will welcome this survey of the project.

A. A. WARE

# Mixture at Low Temperature

**Progress in Cryogenics.** Volume 1. Edited by K. MENDELSSOHN. *Heywood.* (63*s*)

A collection of essays by different authors under a generalised title is almost always a mixed bag, particularly when the title refers to a subject as wide in its scope as low-temperature physics, and this book is no exception. Although purporting to concentrate mainly on the technological side of cryogenics, the two longest articles, "Frozen Free Radicals," by G. J. Minkoff, and "Ultrasonic Attenuation in Metals at Low Temperatures," by R. W. Morse, deal less with techniques than with the present experimental and theoretical status of their topics. They are, as a matter of fact, two of the most interesting articles in the book, though the former is perhaps unnecessarily long-winded.

It would take too long to review each article separately, but it will probably be valuable to list here the titles and authors of the nine contributions, and then to make a few remarks about those of greatest interest. The contents are as follows: "Superconducting Circuits" (D. R. Young), "Thermoelectric Cooling" (D. A. Wright), "Evacuated Powder Insulation" (M. M. Fulk), "Distillation at Low Temperatures" (B. R. Brown), "Mechanical Properties of Metals at Low Temperatures" (H. M. Rosenberg), "Frozen Free Radicals" (G. J. Minkoff), "Low Temperature Calorimetry" (R. W. Hill), "The Determination of Specific

*Continued on next page*

Heats by the Temperature-Wave Method" (N. V. Zavaritsky), and "Ultrasonic Attenuation in Metals" (R. W. Morse).

The article on superconducting circuits is badly planned. No logical sequence is followed, the various devices which have been proposed being simply listed and explained, sometimes not particularly lucidly. Nor is there any critical assessment of the future value of superconducting circuits in, for example, the computer field, and the only two occasions on which an actual time constant of a device is mentioned refer, in the first case, to the very slow original wire-wound cryotron, and in the second to a misleading calculation on the evaporated strip cryotron.

Thermoelectric cooling is dealt with very adequately in Dr. Wright's interesting chapter. The various factors which limit the efficiency of this process are clearly explained, so that the narrowing of the choice of a suitable pair of substances for the thermojunction to semiconductors, and then even further to *n*- and *p*-type bismuth telluride, is shown to be logically inevitable. It seems that this method of refrigeration is likely to be limited to compact and low powered devices maintaining a temperature difference at room temperature of about 50° C.

An apparatus capable of applying a compressive force of 4 tons to a small specimen immersed in liquid helium is one of the pieces of equipment described in the article on the measurement of mechanical properties of metals. This is an excellent brief essay on a subject of considerable interest, which may yield the answer to a number of problems connected with the theory of dislocations in metals.

Free radical research is clearly a subject still in its infancy, but one with an exciting future before it. One visualises the possibility of chemical reactions tailored to an extent hitherto undreamed of, and Dr. Minkoff's article is an interesting though slightly rambling account of the methods used in the isolation and identification of the radicals which have so far been discovered.

The book concludes with an essay by Dr. R. W. Morse on ultrasonic attenuation at low temperatures. This promises to be an important new tool in the investigation of the electronic properties of metals, and has already yielded results of great interest in superconductors as well as in normal metals. A particularly important effect is the oscillatory variation of attenuation with magnetic field, which will probably yield direct information on the shape of the Fermi surface. The article is clearly written and informative.

Each article is accompanied by a thoroughly adequate bibliography of original papers. There is no other index.

It is very difficult to assess as a whole the value of a book in which contributions on so many diverse subjects are collected together. Low-temperature physics is probably one of the least homogeneous branches of research, and it is only the excuse that both require the use of cryogenic techniques that enables topics so widely separated as, for example, frozen free radicals and thermoelectric cooling to appear between the covers of the same book. Most physicists will find something of interest here, but few will be at all closely concerned with more than perhaps half of the material presented.

J. M. LOCK.

## New Books

**British Petroleum Equipment, 1959/60.** *The Council of British Manufacturers of Petroleum Equipment, 2 Princes Row, Buckingham Palace Road, London, SW1.* (50*s*)

A buyers' guide to the products and services of members of the Council, including a large, heavily illustrated section of members' catalogue entries.

**Proceedings of the National Electronics Conference, Volume 14.** *The Conference, 228 N. LaSalle Street, Chicago 1, Illinois.* ($7·50)

One hundred papers on transistors, servo-mechanisms, antennae, audio, automatic navigation, filter design, solid state, microwaves, IGY, instrumentation, engineering writing, computers, and television, presented in October 1958. This series of conferences has now produced 1,182 papers.

**Mechanics.** By J. L. MERIAM. Second edition. Part 1: Statics. Part 2: Dynamics *John Wiley, New York; Chapman and Hall, London.* (80*s*)

Nearly 1,500 simplified practical problems are used very extensively in this text on engineering mechanics in an attempt to convey the principles to the student in an interesting way.

**Mathematics in Physics and Engineering.** By J. IRVING and N. MULLINEUX. *New York and London, Academic Press.* (63*s*)

The analytical and numerical methods that arise most frequently in present day pure and applied science. The subject matter has formed the basis of lecture courses at undergraduate and postgraduate levels.

**Les Armatures Spéciales de Béton Armé et les Armatures (Fils et Barres) de Précontrainte.** *C.E.R.E.S., Universite de Liège, 6 Quai Banning, Liège, Belgium.* (750 *BFrs*)

The proceedings of the RILEM (Réunion Internationale des Laboratoires d'Essais et de recherches sur les Matériaux et les constructions) symposium on reinforcements for reinforced and prestressed concrete. A total of 25 papers were given, from the points of view of both metallurgist and constructor.

**Ferodo Brake Service Guide.** *Ferodo Limited, Chapel-en-le-Frith, Derbyshire.* (40*s*)

A manual for garage and service station use, covering most modern automotive brake systems, and containing sections on brake adjustment, tracing and curing brake troubles, and brake testing.

**A Course of Mathematical Analysis.** By EDOUARD GOURSAT. 3 volumes. *Dover Publications, New York; Constable, London.* (40*s*)

Another mathematical classic, the three volumes originally published in 1904, 1916 and 1917 respectively, now re-issued in substantial paperback form by Dover.

**Jane's Fighting Ships, 1959-1960.** Edited by RAYMOND V. B. BLACKMAN. *Sampson Low, Marston.* (110*s*)

During the year covered the aircraft carrier Hermes was completed, and the nuclear submarine Dreadnought and four "County" class guided missile destroyers laid down for the Royal Navy, major developments were taking place in the United States and the Soviet Union, and the German Federal Navy made a comeback in the field of destroyers and smaller craft. This edition of *Jane* covers some 10,000 ships in 70 navies. A new feature is a two page spread table giving the numerical strength of each country at a glance.

**The Equipment of the BBC Television Film Studios at Ealing.** By N. F. CHAPMAN. BBC Engineering Division Monograph, 27. *BBC Publications, 35 Marylebone High Street, London, W1.* (5*s*)

This illustrated monograph describes the operations and equipment of the film production facilities for the BBC Television Service.

**Electrical Circuit Analysis.** By K. STEPHEN. *Cleaver-Hume Press.* (30*s*)

The author places special emphasis on the use of Kirchhoff's current and voltage laws and their extension by circuit theorems, so as to lay a sound foundation for the more advanced sections of this and later courses.

**Handbook of Heating, Ventilating and Air Conditioning.** By JOHN PORGES. 4th edition. *Newnes.* (30*s*)

A concise manual of data, charts and tables for day-to-day reference by the heating and ventilating engineer. A section is included on labour rates for installation.

## The Reviewers

Mr. C. J. Highton is principal legal and lands officer of the United Kingdom Atomic Energy Authority. He is a B.A.(Oxon) and a Barrister-at-Law (Inner Temple).

Mr. F. R. Farmer, B.A., is head of the Safeguards Division in the United Kingdom Atomic Energy Authority's Health and Safety Branch. Before joining the Authority he served with the Kestner Evaporator Engineering Company Limited where he was concerned with chemical engineering work.

Dr. A. A. Ware is section leader, thermonuclear section, at the Associated Electrical Industries Research Laboratory. At Imperial College in 1947, under the direction of Sir George Thomson, he was the first person to undertake experimental research aimed at controlled thermonuclear reactions. He is a fellow of the Physical Society and an associate of the Royal College of Science.

Dr. J. M. Lock is a member of the scientific staff in the low temperature laboratory of the Royal Radar Establishment, Great Malvern, which he joined in 1951. He had previously spent four years in Cambridge engaged in research on superconductivity. He is a B.A. in physics and a Ph.D.

## Trade Publications

*Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.*

### *Materials*

**Polyethylene Colourants.** BRITISH RESIN PRODUCTS LTD., Piccadilly, London, W1. Colourants best suited for high density polyethylene and methods of assessing their suitability. Leaflet.

**Concrete Hardener.** METAROCK LTD., 1 Sloane Square, London, SW1. "Metarock" is a metallic powder which is used for hardening and proofing all forms of concrete, granolithic and renders. Who uses it, what it is used for and how. Booklet.

**Properties of Steel.** BRITISH IRON AND STEEL FEDERATION, Tothill Street, London, SW1. Third booklet in a series of simple guides to supplement films made by the Federation. First two guides were on basic and finishing processes in the steel industry.

**Aluminium for Vehicle Bodybuilders.** NORTHERN ALUMINIUM CO. LTD., Banbury, Oxon. Noral light alloy sections and castings available for commercial vehicle bodybuilding. Two wall-charts, 30 in by 40 in.

**Packings and Jointings.** TURNER BROS ASBESTOS CO. LTD., Rochdale. Not another catalogue but a text book of interest to engineers everywhere. Well illustrated, 104 pages.

**High Duty Cast Iron.** INCANDESCENT HEAT CO., LTD., Smethwick, Birmingham. Five leaflets IN1-5 inclusive illustrate applications of "Incanite" high duty cast iron.

**Steel Strip and Flattened Wire.** FIRTH CLEVELAND STEEL STRIP LTD., Tipton, Staffs. Ten page booklet on "Firclevе" products including carbon spring steel and mild steel qualities.

**Hollow Bored Bars.** KEETON SONS & CO. LTD., Greenland Road, Sheffield 9. "Keetona" hollow bored bars are supplied in mild steel, high carbon and alloy steel or non-ferrous metals. Sizes; finished components and profile boring. Booklet.

**Chemicals.** ALBRIGHT & WILSON (MFG.) LTD., 1 Knightsbridge Green, London, SW1. Code numbers, physical forms, and packing of firm's general chemical products. Lists over 350 regular products.

**Silicone Rubbers.** IMPERIAL CHEMICAL INDUSTRIES LTD., Millbank, London, SW1. Illustrated summary of grades, properties and applications of ICI silicone rubbers.

**Carbon.** MORGAN CRUCIBLE CO. LTD., Battersea Church Road, London, SW11. First of a series to be published twice-yearly on applications, characteristics and manufacture of carbon products. 44 pages, well illustrated.

**Molybdenised Lubricants.** ROCOL LTD., Swillington, Nr. Leeds. Illustrated booklet shows grades of lubricants and antiscuffing pastes containing molybdenum disulphide.

**Gunmetals.** MOND NICKEL CO. LTD., Millbank, London, SW1. Properties of two new gunmetal compositions. Sixteen page booklet.

**Joining Polyethylene.** BRITISH RESIN PRODUCTS LTD., Piccadilly, London, W1. Procedures for hot gas welding and butt welding together with data on use of pressure sensitive adhesive and polar and hot melt adhesives. Leaflet.

# Marketing

## Mirrlees Success Against Keen Competition

Member firms of the HAWKER SIDDELEY Group have recently been awarded contracts in the face of very sharp competition in South East Asia. The Ministry of Communications for Civil Administration Aviation, Bangkok, acting for the Royal Thai Air Force, has ordered, from MIRRLEES BICKERTON AND DAY Limited, three generating sets of six-cylinder diesel engines driving generators made by BRUSH ELECTRICAL ENGINEERING. Mirrlees are also to supply complete power station equipment including cooling towers, switchgear, compressor sets and pumps.

Other Mirrlees driven generating sets are going to Venezuela, Dutch Guiana and Piura in Peru. All are repeat orders.

## British Tractors Triumph Abroad

An interesting swing in the world tractor markets towards British exports and away from those of Germany, our main tractor exporting competitors, is revealed by the AGRICULTURAL ENGINEERS ASSOCIATION. German tractor sales last year in her 18 best markets fell by £5 million. In the same markets British tractor sales rose by £6 million. This is a swing of 22 per cent in favour of the United Kingdom product.

The association points to another development which is perhaps more important than this. Exports of British farm machinery other than tractors over the last three years have declined by 8 per cent. The drop is largely due to the opening of plants abroad by British manufacturers.

The reduction last year was almost entirely because of lower combine-harvester sales overseas.

## Sheik Alamuddin Buys Four Comets

Fears that DE HAVILLAND's sale of four Comet 4C jet airliners to MIDDLE EAST AIRLINES would fall through themselves collapsed when the arrangement was finally completed in London. The airline's chairman, Sheik Najib Alamuddin, has also taken an option on a fifth Comet 4C. The first of these advanced numbers of the Comet is due to be delivered in December.

The successful completion of the deal is a valuable sales step for De Havilland. The Middle East Airlines decision in favour of Comets may give a lead to others who are hesitating.

Counting in the spares the order for the four jets is in the £5½ million region.

## American Design in an Italian Steel Plant

United States engineering companies combined with the Italian steel firm CORNIGLIANO, of Genoa, over an expansion programme which will double the capacity of the Italian plant to an annual total of two million ingot tons.

The two year project began with the installation of a blast furnace with a capacity of 1,500 tons a day, and is being followed through with a 46 in slabbing mill, one of the largest in the world.

It has been designed by the MESTA MACHINE Company of Pittsburg. The construction in Italy is by INNOCENTI, of Milan. The electrical equipment has been supplied to WESTINGHOUSE specifications by the Italian MARELLI Company.

## AEI Electronics and Radio Division

ASSOCIATED ELECTRICAL INDUSTRIES have set up a new product department, concerned with semiconductors, in its Radio and Electronic Components division. Producing semiconductors in a wide range for industrial and commercial applications, the department will have its sales organisation at the AEI offices in Charing Cross Road, London.

## Stabilisation Plan Gets Spain Moving

Speaking in the Canary Islands on the way home to Britain after his African tour, Mr. Macmillan, the Prime Minister, spoke of the progress which had been achieved in the Spanish economy after recent reforms and looked forward to an increase in Anglo-Spanish trade.

Have the Spanish financial reforms cleared the way to greater trade?

A team of three from the Organisation for European Economic Cooperation has reported on the initial success of the Spanish Stabilisation Plan and stated that inflation has been stopped. The shortage of raw materials has come to an end. Tourist income and remittances from emigrés have been going up, while imports have been kept within bounds.

Stabilisation, say the OEEC three, does not mean stagnation, although it certainly has led to some unemployment, to a general disappearance of overtime on which the working Spaniard had come to depend and to the frequent loss of " the second job."

The Spanish importer, of those goods where regulations have been liberalised or " globalised," is engaged in a vigorous return to normal business conditions and it is here that the chances of other nations increasing their trade with Spain lies.

In financial terms the Spanish trading position has picked up from a position where in the later months of 1958 exports paid for only 63 per cent of imports to a healthier state in the same months of last year when exports covered 92 per cent of the cost of imports.

## Multi-Million Dollar Plywood Contract

Several of the United States firms who will be manufacturing the plywood flooring and roofing panels of TROFDEK Limited within the next two years have capacities equal to that of the whole United Kingdom plywood industry.

Mr. A. H. Cornwall, a director of Trofdek, has recently returned to London from a 25,000 mile trip in North-America where he concluded an agreement which means that firms affiliated to the construction organisation of the DOUGLAS FIR PLYWOOD ASSOCIATION will be licenced to make Trofdek units. The DFP Association is responsible for the production of 7,000 million sq. ft of plywood a year—85 per cent of the United States' output.

## Trade in Czech Machine Tools

The machine-tool industry in Czechoslovakia is perhaps the best known of all those in the Iron Curtain countries. The principal plants are SKODA Works, MAS, SLAVIA, VOLMAN, ZBROJOVKA, KAMENICEK and CESKOMORAVSKA-KOLBEN DANEK.

The industry has a central research and design institute, export and import organisations. Precise figures for production and exports are hard to come by, and the position is made no easier by the political trading policy under which prices are adapted to ensure sales in countries of which it is desired to obtain the currency.

In foreign countries trade is generally initiated through the legations which find representatives for the various machines it is proposed to import. Contrary to usual commercial practice, the Czechs secure different selling agents for each type of machine tool. The big exception to this trading pattern is South Africa, where a local subsidiary has been set up because the potentialities of the South African market are considered better for Czech machine tools than in any other non-Communist country.

In view of the reluctance of other countries to set up subsidiaries in South Africa it is interesting that Czechoslovakia, the most highly industrialised of the satelites, should do so. Czechoslovakia is now the fourth largest European machine tool producing country, and its products range from small standard items up to big tailor-made machines. A CDK boring and turning mill weighing 115 tons was recently shipped to Japan.

## Copper Warning from Phelps-Dodge Chief

The possibility that in order to maintain stable prices and to avoid the damage to the industry of excessive stock piling in copper there will have to be output restrictions in the West has been given by Mr. R. G. Page, the president of PHELPS-DODGE, the second largest copper company in the United States.

## Great Expectations in US Capital Investment

After chilly doubts in the United States and uncertainty that the predicted business expansion in that country was in fact taking place, an altogether clearer picture is now emerging and it includes heavy increases in spending on new buildings, plant and equipment.

Government departments in America now estimate that capital outlay will be 14 per cent greater this year than last, breaking the $36,900 million record of 1957.

The largest increases are expected to occur in the consumer-durable industries and of those the car firms, and, closely linked, the iron and steel industry, appear likeliest to lead the way.

Slow automobile sales have been one of the thermometers that have alarmed the multitude of United States' business doctors but the tempo is evidently picking up.

In fact, the closing days of February were 14 per cent better than those of January and the month taken as a whole was 15 per cent higher in car sales than last year, though still not back up to the high figure of February, 1957.

## Canada Living Above her Means

From just over $1,000 million in 1958 the Canadian deficit in international payments rose last year by almost half —to $1,460 million.

Canada traditionally has a favourable balance from her trade with the United Kingdom but last year her current account surplus with this country fell to $52 million, half what it had been the year before and the smallest surplus in trade between Canada and Britain for 20 years, with the single exception of 1950.

## Fordson Tractors for British New York Fair

Two Fordson Power Major tractors with differing attachments, two Fordson Dextas and an electrically operated sectional working model of the Fordson Power Major engine will be shown at the British Trade Fair in New York in June.

The Ford Motor Company's tractor division at Dagenham in this country will be sending the tractors over and the Ford tractor and implement division at Birmingham, Michigan, will provide the implements.

## Antarctic Film World Success for BP

Five film festivals and translation into 15 languages is the record of success achieved by the BRITISH PETROLEUM film " Antarctic Crossing." This dramatic record was sponsored by the company as part of its contribution to the Commonwealth Trans-Antarctic Expedition.

In addition to commercial distribution in Britain, Holland, Italy, New Zealand and Norway, the film has been televised in Austria, Australia, Canada, Denmark, Germany, Luxembourg and Switzerland.

There is a long and impressive list of people and bodies to whom the film has been privately shown, a list headed by the National Geographic Society in Washington.

## £1 Million Furnace for Rhodesia

The RHODESIA BROKEN HILL DEVELOPMENT Company has ordered a zinc and lead furnace for Northern Rhodesia. This major contract involves two POWER-GAS Companies in work worth more than £1 million.

The two firms are P.G. ENGINEERING, of Stockton-on-Tees, and ASHMORE BENSON PEASE AND COMPANY AFRICA (PTY.), of Johannesburg, South Africa. The two companies will handle the whole of the work from the engineering of the plant, construction at the site and installation of equipment.

# Airhydropump: A High Pressure Intensifier

**Because of the development of high pressure industrial processes, there is need for an intensifier that can deliver oil at pressures up to 100,000 lb per sq. in. Such an intensifier is the Airhydropump which works off a normal industrial compressed air supply.**

*By Professor B. Crossland, The Queen's University of Belfast and R. L. Alexander, Charles S. Madan & Co. Ltd.*

Interest in very high fluid pressures has grown considerably within the last 20 years or more. In the chemical industry, a number of chemical processes and separation operations are now carried out under elevated pressures, one of the best-known examples probably being the production of polyethylene from ethylene, which involves pressures of about 22,000 lb per sq. in. This particular high pressure process was first used on a commercial scale shortly before the Second World War and though a lower pressure process has now been introduced, it is claimed that the properties of polyethylene produced by the high pressure process are superior. Another of the many industrial examples of the use of high pressure is the fairly recently introduced Armstrong air breaker, used for breaking up coal at the coal face.

Besides the increased industrial interest, there has been an increase in the research on problems involving high fluid pressures. These interests range very widely through the many branches of science. For example, research is currently being carried out on the effect of high pressures on micro organisms, and at the other extreme the effect of pressure on the dielectric properties of diamonds is at present being investigated. In mechanical engineering, the effect of pressure on the static and fatigue properties of metals has led to results of considerable academic interest (e.g., see refs. 1 and 2). Another investigation of importance, in problems of lubrication in heavily-loaded bearing applications and the lubrication of metal forming processes, such as wire drawing, is the determination of the viscosity-temperature relationship of oils and greases under high ambient pressures.

The development of high pressure industrial processes has made it necessary to carry out proof tests and tests to destruction on individual high pressure components. As a result, there has been a growing demand for an intensifier capable of delivering oil at pressures of up to 100,000 lb per sq. in, and there is also a demand for such an intensifier for research.

Perhaps the simplest way of obtaining high pressure fluid is by using a screw jack to produce the force required to push a ram into a high pressure vessel filled with the fluid. With suitable cocks or ball valves, it is possible with such a pump to make as many strokes as are necessary to reach the desired pressure. This is, however, an inefficient and cumbersome way of producing high pressures and possibly a more elegant and cheaper method is to use a lorry (or car) jack to force the ram into the cylinder (ref. 1). Basically, this is a simple form of intensifier, in which a low pressure, acting on the large diameter ram of the jack, produces a force which is used to generate a higher pressure in a smaller bore high pressure cylinder. These methods are only of use when the required delivery is small and the leakage from the system is negligible, but in many applications an automatic intensifier is desirable if the volume in the high pressure system is large or the leakage more serious.

In refs. 3 and 4 an automatic intensifier has been described with a ratio of low to high pressure ram areas of 16, which, with a pressure of about 7,000 lb per sq. in on the low pressure side, gives a delivery pressure of 100,000 lb per sq. in. The low pressure oil is produced by a motor-driven diesel engine injector pump, the motor of which is started and stopped by a pressure-sensing device in the form of a dead weight piston gauge in the high pressure circuit. At the end of one stroke, a change-over cock is brought into operation which connects the injector pump output through a ball valve to the high pressure cylinder, while the low pressure cylinder is connected to the reservoir, so that when the injector pump motor is next started it recharges the high pressure cylinder. During this recharging stroke, the high pressure circuit is isolated by the outlet ball valve. In this intensifier the $\frac{3}{4}$ in diameter high pressure ram, which has synthetic rubber packing rings at its head, fits into an accurately lapped three component vessel designed to avoid yield at the highest operating pressure.

In recent years, an air-operated automatic intensifier has been developed which works from a normal industrial compressed air supply to produce pressures up to 100,000 lb per sq. in. This "Airhydropump," based on a successful design for pressures up to 55,000 lb per sq. in

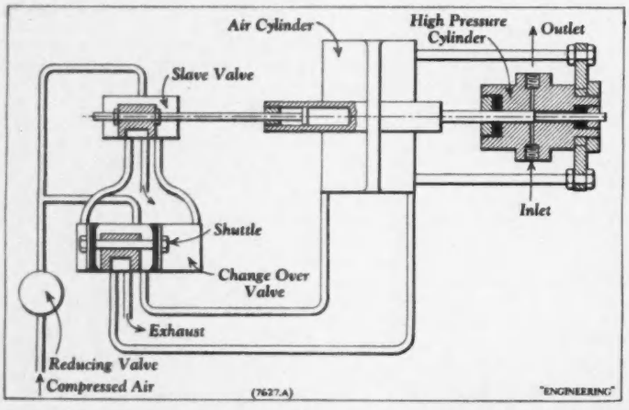



*Fig. 1 Diagrammatic arrangement of the Airhydropump.*

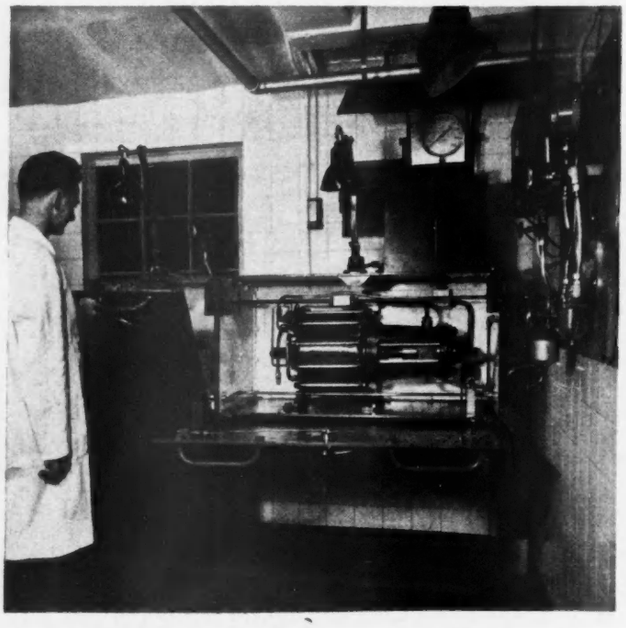
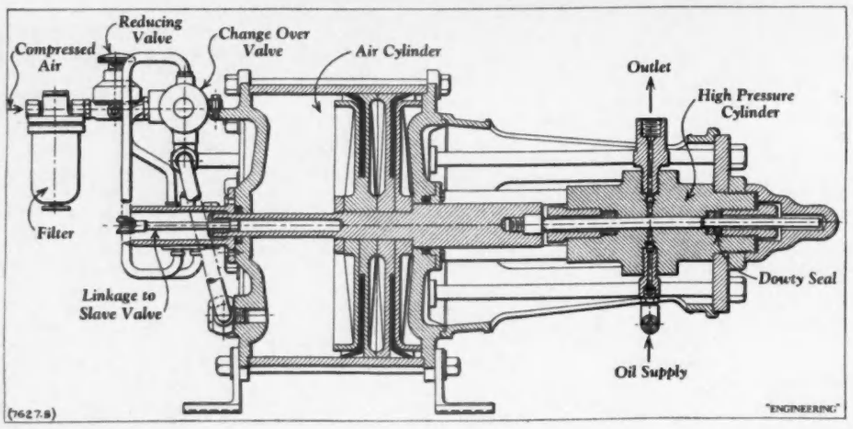


*Fig. 2 (right) The Airhydropump to develop 100,000 lb per sq. in, contained in a safety cabinet.*

*Fig. 3 (below) Detail of the intensifier.*



and manufactured by Charles S. Madan & Co., Ltd. of Altrincham, Cheshire, will now be described in detail.

A diagrammatic layout of the airhydropump is shown in Fig. 1. On the delivery stroke of the intensifier, compressed air is connected to the left hand side of the relatively large air piston, and this forces the differential area ram into the high pressure cylinder and the fluid is delivered through the outlet ball valve to the high pressure circuit. Towards the end of the delivery stroke, the motion of the piston rod actuates a slave valve, which changes over a compressed air connection from one side to the other of the valve shuttle in the change-over valve. This forces the valve shuttle to the other end of the cylinder, disconnects the compressed air supply from the left hand side of the main air piston and connects it to the right hand side, and at the same time connects the left hand side through a silencer to atmosphere. During this charging stroke, fluid enters the high pressure cylinder from the low pressure supply, and the high pressure circuit is isolated by the outlet ball valve. Towards the end of the charging stroke, the motion of the piston restores the slave valve to its original position, which, through the change-over valve, reverses the compressed air connections to the main cylinder.

### SEALING ARRANGEMENTS

The fluid pressure produced by the intensifier is very simply controlled by a reducing valve in the compressed air supply to the pump. As a consequence, the pump continues to deliver until the force on the air piston is just balanced by the frictional and pressure forces on the high pressure ram. If the pressure falls, the pump automatically starts to deliver again. This gives a surprisingly accurate control, but if it is thought desirable to control the pump by a pressure sensing element in the high pressure circuit (such as a dead-weight piston gauge), this can readily be done by incorporating a solenoid operated on-off valve in the compressed air line.

Fig. 3 shows the intensifier in greater detail and Fig. 2 is a photograph of the unit and the safety cabinet in which it is housed. It will be seen that the differential diameter high pressure ram passes through two high pressure seals which are unsupported area seals, supplied by Dowty Seals Limited. These unsupported seals (ref. 5) were initially developed for liquid springing in aircraft undercarriages. They have been well tried up to pressures of 55,000 lb per sq. in in service, and have been used at 85,000 lb per sq. in for research. In this particular application they have given little trouble at 100,000 lb per sq. in, but when the pump is operated frequently at the maximum pressure (or is used for bursting tests on components), the seals occasionally have to be replaced. However, the seals are so arranged that they can easily be renewed.

The differential diameter ram has been used in this design to obtain a stiffer and more stable ram, which would not otherwise have been possible, as with an area ratio of 1,555 : 1, and limiting the diameter of the air cylinder to 14 in, the diameter of a simple ram would only be 0·355 in. With the design shown in Fig. 3, in which the seals are located at each end of the high pressure cylinder, it is not so important to design a cylinder that will remain completely elastic; all that is important is for there not to be excessive plastic distortion of the cylinder, which means that the collapse pressure (cf. ref. 6) should be less than the maximum working pressure. Consequently, with a maximum working pressure of 100,000 lb per sq. in it is possible, using a reasonably high tensile material, to have a simple monobloc cylinder, which is not possible in the intensifier design described in ref. 3. It will be realised that during the first application of the maximum working pressure, the cylinder will become autofrettaged and subsequently the permanent dimensional changes will be small. From ref. 2 it must be appreciated that the life of this cylinder, especially with a radial hole through the wall, cannot be infinite, but in our present state of knowledge it seems unlikely that a cylinder could be designed to work at these pressures and have an infinite life. However, the high pressure cylinder should have a life of at least several thousand cycles, which should be adequate for most, if not all, applications.

It should be emphasised that it is essential to take positive safety precautions, not so much in case of a failure of the high pressure cylinder, but to prevent serious injury or damage from failure of the component under test. This is especially important if the volume of fluid under pressure is large, or if there is any probability of air being trapped in the high pressure circuit.

The outlet from the Airhydropump is designed to suit the range of high pressure fittings and valves also produced by Charles S. Madan & Co.

### References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# Gyro Compass for Canberra Liner

For their liner Canberra, the P and O Steam Navigation Company Limited have chosen a gyro compass and steering control equipment produced by S. G. Brown Limited of Watford.

The complete gyro compass, including switchboard and transmission unit but not the generator, has a volume of less than 1 cu. ft. Requiring no maintenance by the user, it is completely unaffected by vibration and the severest ship movement and therefore needs no special site or compartment. In the Canberra it will be sited on a small bracket convenient to the navigator.

The Arma Brown gyro will provide the datum for automatically steering the ship, provide heading reference to the steering repeater incorporated in the main steering control unit, feed a rotatable repeater in the after steering compartment, and bearing repeaters situated in each wing of the bridge and the upper bridge deck. A special silent running heading indicator, also fed from the master gyro, will be placed in the captain's cabin.

The auto-electric steering control, which is similar to that being fitted in new warships and many other vessels, from tankers to trawlers, replaces the conventional telemotor transmitter and hydraulic steering control of the Brown Brothers steering engine.

The main steering position on the bridge provides in one small unit two independent methods of direct-acting, hand electric steering control, as well as automatic steering using the Arma Brown gyro as datum. The bridge unit incorporates the changeover switch providing instantaneous switching between any of the three methods of steering, in addition to helm and rudder movement indicators. Changeover switches between the two after power units connected to and controlling the steering engine, as well as between duplicated power supplies, are also incorporated. In addition, a course trimming unit, enabling small alterations of course to be made while in automatic steering, as well as sea and weather controls, are provided.

*(Left) The Arma-Brown transmitting gyro compass for the P and O liner Canberra.*

*(Right) Secondary steering control unit.*

Forming part of the complete system, and providing over-riding emergency hand steering control when the ship is being steered automatically, are two small remote control units placed one in each wing of the bridge. Each remote control incorporates a rudder movement indicator. In these positions heading reference can be taken from the bearing repeaters.

On the bridge also will be the rudder angle indicator, fed from a transmitter attached to the rudder stock. This transmitter will also feed a special small rudder angle indicator incorporated in the main control console situated in the engine room.

Incorporated within the complete steering control system, and located in the after steering compartment, will be the electric steering control unit. This provides two independent methods of hand electric steering control of the steering engine but not automatic steering. Although using the same duplicated after power units as the main steering control position, this secondary steering control operates quite independently.

# Will Our Children Motor More Than Us?

**The increasing number of vehicles on British roads is likely to be the result of changes in taste rather than rise in incomes. In the United States increased travel per vehicle is envisaged.**

How much money is spent on petrol for private motoring? A recent estimate by J. S. Cramer, department of applied economics, Cambridge University, puts spending in 1953-54 at £137 million, or just over 17*s* per week per motorist. This is more than twice the figure (£64 million) used by the Central Statistical Office for building up the estimate of consumer expenditure on the running costs of private motoring given in *National Income and Expenditure*. While admitting that there is the possibility that his estimate may be high, Mr. Cramer considers that this cannot account for the whole of the observed discrepancy. He concludes that the "Consumer Expenditure" series for running costs must be regarded as an underestimate as far as petrol is concerned.

The model of the petrol consumption situation used in the analysis (Journal of the Royal Statistical Society, p. 334, part 3, 1959) is based on the distinction between motorist and non-motorist households and on the assumption that motoring, however modest its scale, requires a definite minimum expenditure on petrol and oil. Three separate assumptions are stated explicitly.

The first assumption refers to individual preference for motoring—to the frequency of motoring households at different levels of income. It is based on the idea that each household has a definite income level below which it would not take up motoring. A distribution function is set up to account for the variations in taste for motoring, from which the expected proportion of motoring households at a given income level can be deduced from the fraction of households that have a tolerance income lower than the given level. The fraction approaches unity asymptotically as income increases.

The second assumption refers to the petrol consumed by households. Consumption is zero when the income is less than the tolerance income. Motoring households are considered as spending a constant minimum amount, plus a variable amount proportional to the amount by which their income exceeds tolerance income.

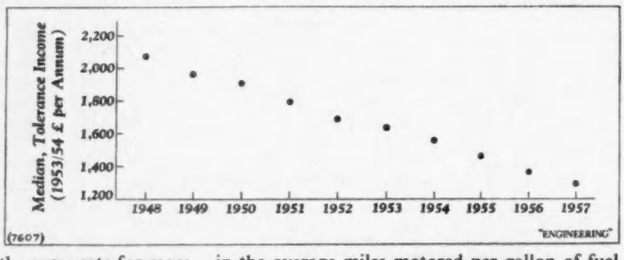
The third assumption connects the two indications of individual preference: the individual minimum expenditure bears an inverse relation to the tolerance income level of the household. Keen motorists, or households that have a real need for private transport, will acquire a vehicle at a relatively low level of income and use it extensively. At the other end of the taste scale are individuals for whom motoring represents an inessential luxury; so that when they are so rich as to buy a car they use it very little.

The various equations expressing these assumptions in precise form are used in conjunction with the results of the Ministry of Labour inquiry (1957) and the Social Accounts of Cambridgeshire Survey (1954, 1956). One point brought out by the method is the different tastes of urban and rural households. This is illustrated by the median tolerance income, which indicates the level of income (or, for the figures used in the model, the total expenditure) at which half of all households are motorists. In rural and urban districts of Cambridgeshire this situation occurs at a little over £800 and £1,000 respectively. But the figure for the United Kingdom as a whole, as shown by the Ministry of Labour inquiry, is over £1,600. This substantial difference reflects the greater preference for motoring in rural areas, the Ministry of Labour sample probably being more urban in character than the city of Cambridge.

Without any model and without allowance for the bias of the sample, the petrol expenditure on private motoring would work out at £99 million per year for the whole population. While this is an underestimate, it sets a limit to the overestimate due to the particular assumptions in the model, which raises both the proportion of motorist households and their average petrol and oil consumption by about 15 per cent over the unadjusted Ministry of Labour sample statistics.

### SHIFT OF TASTE

Having established a model for the variation of individual demand, Mr. Cramer looks at its implications for the market demand for motoring and motor spirit. It turns out that rise in incomes explains only a minor part of the observed increase in motoring, and that other powerful factors making for its expansion must have been at work. Over the years these show little relation with price variations or supply conditions such as delivery periods and hire-purchase regulations. Their effect can therefore be described generally by a continuing shift of the taste distribution. Since 1948 the median tolerance income has fallen from £2,000 to £1,300 (1957), using 1953-54 price levels. The fall has been linear and shows no sign of levelling off.




*The income level at which half of the households are motoring decreased steadily between 1947 and 1957.*

But it cannot continue at the same rate for more than a few years.

As far as expenditure per motorist on petrol and oil is concerned, the main point of interest is that it has risen very little. This is related to the fact that the rise in motoring generally is ascribed in the analysis to a shift in taste rather than to rising incomes. The effect of the former on expenditure is less than the effect of the latter: the influx of new motorists at lower income levels keeps down the average spending on fuel. If the further development of motoring depends on a further shift in taste rather than on rising incomes (and present trends suggest this will be true in the near future), the demand for petrol and oil will rise no faster than the vehicle population.

### TRENDS IN THE USA

A different pattern of expansion in petrol consumption is envisaged for the United States in a forecast by the Office of Research, US Bureau of Public Roads (published in the February issue of *Public Roads*). Unfortunately their forecasts are not directly comparable with Mr. Cramer's, as no attempt has been made to forecast the trends for private motoring alone; all vehicles are considered.

According to forecasts made by the State Highway Departments, there will be 230 million people living in the United States in 1976. During that year, these people are expected to register 114 million motor vehicles, which will travel 1·2 billion passenger miles. Thus a 37 per cent increase in population over 1956—the base year of the forecasts—is predicted and an increase of 75 per cent in motor vehicle registration and 93 per cent in travel.

The anticipated increase in average annual travel, and hence petrol and oil consumption, implies an increase in the average annual travel per registered motor vehicle. In 1956 the average vehicle travelled 9,566 miles; by 1976 this figure is expected to increase to 10,562—about 10 per cent up. Although this is a relatively small percentage increase, doubts have been expressed about the validity of the forecast. Such doubts are based largely on the belief that a family owning one vehicle and driving it 10,000 miles per year will not, on becoming a "two-car" or "car-and-truck" family, drive each vehicle 10,000 miles per year. The Bureau consider, however, that although this consideration is a valid one, there are several other factors that may have considerable weight in determining future rates of travel per vehicle. Among these are the expected continuing accelerated development of suburban areas; the development and expansion of the highway transport industry; the anticipated growth in the USA economy, wealth, and population; and increased leisure time brought about by increases in per capita productivity.

The effects of such considerations are likely to be felt in the United States before they are felt in Britain, and it is unlikely that they will invalidate Mr. Cramer's conclusions in the near future.

The actual increase in fuel consumption in the States during the 1956-76 period is expected to be 94 per cent, an increase of 47,000 million gallons. Thus there is expected to be very little change in the average miles motored per gallon of fuel. In 1956 the average m.p.g. was 12·46; in 1976 it is expected to be 12·36. The constancy of this value appears, however, to be largely connected with a reluctance on the part of State Highway Departments to introduce another variable into their forecasts.

It is interesting that in discussing the value of their report, the Bureau point out that one of the most critical aspects in which background data were lacking was the classification of travel by rural-urban areas. As analysis in Britain has shown, there are marked differences in the motoring habits in the two types of area. Other aspects on which data were felt to be lacking were the projected growth of metropolitan areas and the future economic and population expansion in the States.

The Bureau points out that forecasts of travel in the past have in practically all cases fallen woefully short of reality. It was not until the apparently close relationship between gross national product and total travel was observed that forecasts of travel were put at a level considered to be realistic. The Bureau believe that this historic close relationship has led to a tendency to extend it into the future—to tie traffic forecasts rather closely to expected expansion of gross national product. In view of the developments of the last decade, this procedure, which disregards the changing composition of the gross national product, could quite possibly result in a too-conservative estimate of the growth of travel.

In fact, examination of the trend of growth in the two series in the USA since 1950 show that the total travel is increasing at a more rapid rate than the gross national product. Whether it will continue to increase, relatively, is problematical, but the most conservative extension of the 1950-58 trend would result in a 1976 travel estimate considerably higher than the one developed in the Bureau's report.

# Revised Philosophy for Computer Users

**The impact of automation on industry has created a great amount of interest in electronic computers, but, at the same time, many misconceptions have arisen.**

In only a few years, the electronic computing machine has evolved from a highbrow laboratory instrument into an extremely useful tool for both industry and commerce. In fact its rate of progress has been so bewilderingly fast that there has been very little time for the potential users of such devices to properly understand the philosophy of their application. In an effort to ease this situation, the British Institute of Management recently held a conference, at which a number of computer specialists gave their views to an audience of senior executives.

Outstanding in the lessons that were passed on by several of the speakers was the length of time it may take for a firm to prepare its appraisal of whether a computer can be usefully brought in, to adapt the methods of control for its introduction and then to get the system running. Up to two years appeared as a conservative estimate for a quite medium sized firm.

An introductory speaker roundly declared that computers were morons, capable of doing only as they were told. Helpful or not, the remark was later capped by Mr John Diebold, a well known American consultant who recalled that in the early 1950's it became the symbol of a United States company's progressive attitude to have a computer on order. When the computers began to come along, the American economy was temporarily in a condition where cutting every possible cost was the order of the day. Accountants then found that while they were devising savings in every direction the very costly computer was "coming in at the back door" with its high rental bills and demands for office reorganisation.

A detailed explanation of how a company's executives should go about appraising the part a computer could play in their business was given by Mr. David T. Caminer, a director of LEO Computers Limited.

Mr. Caminer said "I would not want it to be thought that it is necessary for a firm that has perhaps devoted less effort than it might have done in the past to the management sciences, to spend a period of years making up the lost ground before going forward to electronics. Sometimes, I know, punched card firms will tell such an organisation that to go from its manual methods to the electronic computer in one step is too great a leap and that a steady progression from simple tabulators, to electronic multiplying punches, to plugboard computers and only reaching a full-scale computer when they have gained experience, is the right way to go.

## WRONG ADVICE GIVEN

"This is advice with which I do not agree, even though I am well aware that it is offered honestly and sincerely. I do not agree with it because it seems to me to shirk the issue. True it mechanises what is already being done. Indeed, the very case for this step by step transition is that it will cause fewer upheavals and make fewer demands on the existing management than the all-in-one transition. But merely to clothe the past in a cellophane envelope will get the user nowhere. What is perfectly true is that firms starting off on their appraisal, without a developed basis in the management sciences, will need greater external assistance than one which over the years has made the best use of what has been available, has recognised office management as a skill in its own right and has cultivated a well-rooted organisation and methods body.

"It seems to me that there is much too great a readiness for senior people here to content themselves with a feeling that it is all black magic and that at their age they are quite incapable of comprehending what it is all about. I know that on the Continent—in Germany, France and Italy—there is a much greater readiness for top management to seek a background knowledge of the subject and to spend a week or so on a course acquiring such a knowledge.

"Here, to spend a week in such a way is foreign to most of our boards. They throw up their hands and say that they could not possibly spare the time or that they are content to be advised in such matters by this officer or that. For this reason, I found it most refreshing to hear, a month or two ago, of an important and developing company starting its full-scale studies of the possibilities of a computer by having its whole executive board attend a week's course on what makes electronic computers tick, what work they can do and what organisational structure is needed for them.

"The most important step of all in the making of the appraisal is the appointment of the executive to conduct it and to submit recommendations. The extent to which the board are prepared to make sacrifices in freeing somebody for this work might well be taken as a measure of the success that the company are likely to have in this field.

## FOUR POINTS

"In making his appraisal, the executive will want to resolve four main points:

(1) What work the computer could do in the organisation?

(2) What would be the economic effect of doing that work?

(3) What would be the cost of introducing a computer system be?

(4) If the foregoing add up to a prima face case for going ahead, what should be their next steps?

"In assessing the work that the computer could do it is imperative that a global view is taken of the company's activities, and that the study is not departmentalised or restricted solely to the conventional clerical fields. With businesses growing in size and complexity and often seated in several different locations, there has grown up a functionalisation and a division of labour which, commencing to meet immediate needs in the light of existing equipment, has tended to become sanctified as the established order.

"We are all of us here aware of this fragmentation of the paper work and control structure of our businesses. Sales invoicing and sales statistics under the control of the sales manager; depot replenishments under the control of the distribution management; stock control under the stores manager; costing under the cost accountant; purchase verification and invoice verification under the buyer; forward forecasting of sales and purchasing and manufacturing requirements under the production control department or the statistician or perhaps not formally done at all. These are divisions which the appraisal executive has to break through. He has to see the picture whole, even though he might well decide, having looked upon it, that it cannot or indeed does not need to be dealt with all at once.

"If the systems are at all complex, the appraisal executive might well find himself budgeting not only for programmers of his own, but for an expenditure of £5,000 to £10,000 or so on the manufacturer's consultancy and programming services. For in such a case unless the manufacturer is prepared to take the responsibility for getting the first jobs safely launched on the computer, there is little hope save in the most exceptional circumstances, that the project will ever get a clear start at all. And no manufacturer is in a position to give many men months of skilled assistance without recompense. He will be budgeting, too, for the fact that as one procedure after another beds down it might be a year or more before the computer, even if all goes according to plan, can reach its scheduled load."

Mr. John Diebold's review of the computer situation brought some comfort to those whose companies are not big nationally known names. One speaker from the floor observed that the cost of some of the new computers, up to £850,000 in the USA, was more than the issued capital of his company.

"Directly related to technical developments and to increased competition in the computer field there was an awakening of interest in the 'small company.' For several years, many small companies felt that automatic data processing was just one of the many factors making life easier for the big firm and harder for the small. Much of this was unwarranted self-pity, for service bureaux and rented time on machines have long been available," said Mr. Diebold.

"Computer manufacturers have begun to develop special machines. In America, the IBM 1401 is the best known example of this, a development that has been made possible only by the technical developments that are the basis for the larger machines as well. In Europe there are already other machines that are even less expensive, and no doubt this will be the forerunner of an important trend.

## SMALL MACHINES

"Properly used and properly approached, these smaller machines open up whole new areas and possibilities, but they are accompanied by dangers as well. Already, many firms are ordering the smallest and cheapest on the assumption that 'they can't go wrong' by starting there. Others are finding a stronger reason (because it is cheap) to obtain a 'computer' for the sake of having one, when conventional punched cards would do as well and cheaper. In addition, it is now easier to make a bad computer system pay. Before, to justify an expensive machine on a sound basis, it was almost essential to do a thorough, all-inclusive system design, although there are certainly enough exceptions to this statement. Today, it is even easier to avoid doing a thorough, really worthwhile job.

"In addition to developing small machines, computer manufacturers in America have taken a new interest in the service bureau concept. These new sources of computer time are called data centres, and they are really service bureaux without the frills. The using firm does its own programming and systems work, and obtains only time from the data centre. This enables small and medium size firms to take advantage of the inherent superiority of the large machine."

"There remain a great many difficulties, as much among those who have to make proper use of them as among the machines.

"There is, for instance, still a very severe shortage of people who are qualified to develop really good automatic data processing systems. People must be trained, and then they must gain experience. Perhaps more important than training the systems people is the need to educate management. Not only is there a tremendous task to be done in making management aware of what computers can do, and thus convincing them to undertake the cost and effort involved in system study and design: there is also the more basic need of finding how management makes decisions, how organisations are run, so that systems designers can have goals that represent the real data needs of the company. It is this area of management education and specialist training that remains one of the major obstacles to full use of automatic data processing."

# New Facilities for Railway Research

**All the research services of British Railways were inherited from the private companies that existed before nationalisation. These facilities are now being reorganised and centralised.**

A new, modern-styled and well equipped, research laboratory was opened on 11 March by Sir Brian Robertson, chairman of the British Transport Commission. The new laboratory, built on the site of the former Alexandra Palace railway station, at Muswell Hill, London, will be used for the chemical services of British Railways. Its completion is said to mark the first step in the reorganisation and expansion of the British Railways Research Department.

This reorganisation is being undertaken to provide an up-to-date and economical research service for the railways and, when required, for other undertakings of the British Transport Commission.

Since 1951, the activities of about a dozen chemical laboratories, which were inherited by the Commission from the former railway companies, have been coordinated. Most of these laboratories are incompatible with modern research practice and, since the expensive apparatus used today is only economic when given wide use, it is intended to concentrate the chemical services in fewer laboratories. These, centralised, laboratories will serve all parts of the railway system.

The new building at Muswell Hill, which is the first of these centres, accommodates the headquarters staff of the Chemical Services, the London Area Chemical Laboratory, the Building Materials Laboratory and the Corrosion Laboratory, which were formerly at Euston, Stonebridge Park, Wimbledon and Derby, respectively. It also replaces the Stratford Laboratories of the former LNER, which were destroyed by bombing during the Second World War.

The London Area Chemical Laboratory serves a much wider area than its name implies; it extends to Sheerness, Aldershot, Reading, Oxford, Leamington, Rugby, Peterborough and the Wash. It undertakes the routine testing of materials, other than textiles; claims investigations into the causes of damage to goods in transit; laboratory investigations for the BTC police; the examination of water supplies, fuel and foodstuffs; the control of chemical manufacturing processes such as oil blending, battery manufacture, electroplating, etc.; and research problems arising in these fields.

The Corrosion Laboratories serve all parts of British Railways. They investigate problems of metallic corrosion in structures and equipment exposed to exceptionally severe conditions, and they give advice on the use of methods and materials of construction which may prevent corrosion. Since the large scale adoption of diesel traction, particular attention has been devoted to corrosion in the cooling systems of diesel locomotives.

In the Building Materials Laboratory investigations are carried out on new materials, and in the rectification of defects in existing structures, for example, the reinforcement of decayed brickwork. Research is also carried out into improvements in special acid and corrosion resisting cements and other materials.

Most of the floors of the new building are covered with pvc acid-resisting tiles, and the walls are in plaster, or acid-resisting tiles where processes require such treatment. Ceilings are soundproof and flame-resistant. Large windows have been provided for the main laboratories and are fitted with venetian blinds to combat glare and solar heat. Artificial lighting is generally of the fluorescent type.

## MANY SERVICES

Benches and fittings in the laboratories have been specially designed for the requirements of each department and the services, which include water, gas, electricity, compressed air and vacuum, are distributed by two large vertical ducts extending from the bottom to the top of the building. These are connected below the basement floor by a horizontal duct and under the first floor by a full-width false floor, which allows flexibility on the placing of benches.

Additional services, among which is a sampling room where materials are reduced for analysis, are situated on a semi-basement floor. Also in the semi-basement are: a washing-up room, for cleaning laboratory glassware; a room containing equipment for a high frequency radio communication staff location system; two laboratories; and a mixing room, where concrete and mortars can be mixed under controlled conditions.

From the mixing room an air lock gives access to a curing room in which specimens are cured in air saturated with water vapour at a controlled temperature. The design of this room is unusual in that humidity control is effected by a curtain of water flowing down expanded aluminium sheets on three of the walls. Not only does the water provide the requisite humidity, but it falls from a high level tank fitted with a thermostatically controlled electric heater so that the temperature of the room is also maintained by the water curtain. Water from the curtain is collected and recirculated. Concrete and mortar specimens are also cured by full immersion in water contained in polyester-glass laminate tanks.

Both the corrosion and building materials sections require to work with aggressive gases and liquids, and these investigations are carried out in the semi-basement, in a room which might be described as a large fume cupboard. An exhaust fan draws the obnoxious gases away at ceiling level.

Broadly speaking, the ground floor of the building is taken up with administrative offices and a reception centre. However, due to the weight and bulk of the machines involved, a room equipped for the testing of building materials and plastics, and for compression, bending and tensile strength tests is situated at this floor level.

The first floor contains most of the laboratories, linked by a series of swing doors. Analytical control, which is the responsibility of the area chemist, is mostly undertaken in the main laboratory on this floor, sometimes with the assistance of the claims laboratory.

The main corrosion laboratory is also on this floor together with the spectrographic and water laboratories. The latter is equipped for both chemical analysis and bacteriological investigations. A balance room and a photographic dark room provide a common service for the building and there is a central technical library, conveniently situated, close to the main laboratories.

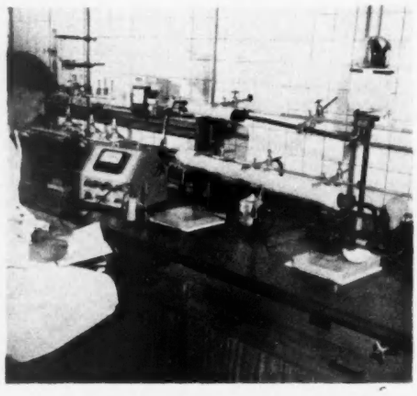


*Fig. 2 Apparatus has been set up to simulate the corrosion conditions existing inside the cooling system of a diesel locomotive.*

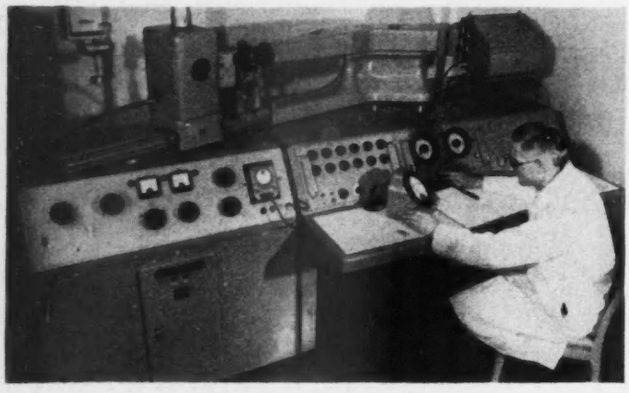


*Fig. 1 A mass-spectrograph is now being used as an analytical monitor for diesel engine fuels. Being almost entirely automatic, it can analyse an oil sample, in a matter of seconds, with only semi-skilled supervision.*

*Fig. 3 A laboratory is available for the mechanical testing, e.g. compression and tensile strengths, of building materials. Two bollards, containing several electrical power points, are conveniently situated in the middle of the room.*

# New Fields for Electrical Research

The amount of research work carried out by different firms within their own organisations varies enormously. Each must have its own problems and its own way of tackling them and of course, there is always the aim of being just that bit further ahead than the competitor. Thus much research is at the least confidential.

Unfortunately there is inevitably a great deal of over-lapping where firms have problems in common. From a planning point of view this is wasteful of manpower and the planners naturally cry out for cooperation to get the result with the least expenditure of cash and talent. Individual firms may have their doubts about the particular value to them of pooled results, but in many cases groups have grown up within an industry for the purpose of carrying out research on problems common to all.

In this country there are particular facilities for setting up such establishments. If a group can put up a minimum sum then the Government are prepared to match it pound for pound. This state of affairs does not last, however, beyond the start. Thereafter as the income of the establishment from firms increases, the grant from the government decreases; for an income of £200,000, say, the grant may be £100,000, but for an income of £250,000 the grant may fall to £50,000. In other words, once an establishment has in fact been established it is expected to maintain itself.

Such a body is the Electrical Research Association whose premises are at Leatherhead. It has a long and proud history of fundamental research to its credit, having been involved in the work of preparing Callender's steam tables, drafting British Standards on cable ratings and many other subjects and of carrying out almost all the fundamental work that has been done on earthing—a good example of a problem that is truly common to all the electrical industry.

Dr. H. G. Taylor, the director, has described the progress of research as a steep upward curve while the basis of the problem is being worked out, followed by a peak where the main work is being done and ending with a falling off during which the last few " bugs " are ironed out. The ERA play their main part in the beginning and the end sections of the curve; the middle part usually falls to the members firms themselves.

As with all such work, the question of secrecy ranks large. An arrangement has been worked out whereby firms sponsoring special items of research are given the results immediately while publication to the rest of the members of the association is delayed for a while. This gives those mainly concerned a chance to make use of their knowledge while still giving the results wide publicity in due course.

In the past nearly all the work has been devoted to " heavy " electricity—that is problems concerned with the production and distribution of power in large amounts. It is probable that nearly all this work has reached the downward part of the curve and such items as transformers and cable ratings may be taken as examples of this trend. Therefore the association is spreading its activities into the field of electronics where so much yet remains to be done. In fact it might be said that the surface of work on this subject has only been scratched.

# Precision Servomechanism Synchro

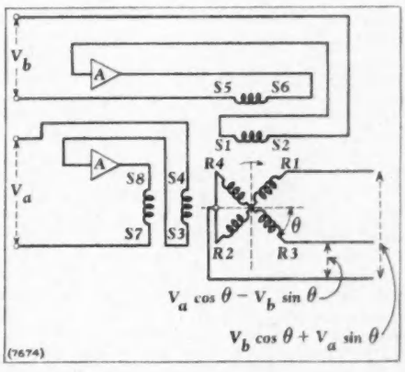
Instrument synchros (error detecting devices) have in recent years been introduced for a wide range of servomechanism applications. One of these devices recently developed for special applications by the Sperry Gyroscope Company is known as a " synchro feedback resolver," and may be used, for example, in analogue computers. Its purpose is to multiply the analogue signal by the sine or cosine of the angle set in on its rotor shaft.

According to a report given in the latest issue of the *Sperry Review*, the synchro feedback resolver was developed primarily to overcome the varying input/output phase shift and transformation ratio which is associated with normal synchro resolvers. These variations may be introduced by changes in any one of several factors, each inherently variable with ambient and operating conditions.

The effects of these conditions, input voltage, frequency, winding resistance, temperature, etc., are nullified by the introduction of a second stator winding in each phase, associated with a high gain amplifier in a feedback loop. This system detects any deviation in flux direction and strength by measuring the induced e.m.f., and varies the voltage applied to the main exciter winding proportionally.

Other functions of the feedback system are the elimination of errors due to in-phase voltage drop in each main winding, and the provision of a cross winding of zero effective impedance; the latter also cancels spurious quadrature voltages mutually induced between the separate stator phase windings. In addition the amplifier and feedback loop cancel out the effect of manufacturing imperfections, which inevitably arise, even under controlled production conditions.

A typical application of the synchro feedback resolver is the vectorial addition of wind velocities for the determination of true wind speed and direction from a moving vessel.




*Example of a synchro feedback resolver, having the following characteristics: phase quadrature accuracy, ± 3 min; sine voltage accuracy, 0·2 per cent; phase shift, 0°; transformation ratio variation, 0·05 per cent (max).*

# Russian Translated By Computer

Research workers at Harvard University have discovered a means of analysing the grammatical structure of Russian sentences, by using computing machines. The discovery is said to be a significant advance in the attempts that are currently being pursued to translate technical Russian into English by machine.

For the past seven years, linguists and mathematicians at Harvard have been preparing, under the direction of Professor A. G. Oettinger, an automatic Russian-English dictionary which now contains 15,000 Russian words and their English equivalents. This dictionary, in the form of a magnetic tape in the memory section of a computer, can produce rough, word-for-word translations of Russian scientific articles; but it cannot unravel the complexities of syntax within a Russian sentence.

A new technique, known as " predictive analysis " is now being used to resolve these puzzles.

Predictive analysis is based on fundamental work which was carried out at the US National Bureau of Standards; as used by Professor Oettinger, it identifies the grammatical role of each word in the sentence being translated, such as subject, verb or object. By checking the inflected endings of Russian words the system can connect a word with its own modifiers.

A single word in Russian may be eligible for several jobs within the sentence being translated. To decide which form the word actually has, the machine makes use of a " predictive pool." This " pool " enables the machine to decide whether an adjective modifies the subject or object by its position in the sentence. If the subject of the sentence has not yet appeared, the machine will select the nominative form for the adjective, putting the possibility that the adjective modifies the sentence's object in a " hindsight " section of its memory. If the subject has already appeared in the course of analysis, the machine will choose the accusitive form as most probable.

Once the subject of a sentence has appeared during the analysis, the prediction that the next word will be the subject is removed from the prediction pool. The machine proceeds through the sentence in this way, one word at a time, until it reaches the end. Each word determines the most probable grammatical form of the next word in the sentence. At this point the machine checks to see whether all the requirements for a complete sentence have been met. If they have, the machine proceeds to the next sentence. If not, the machine checks its hindsight section in an attempt to correct the situation, trying various alternatives until the analysis of the sentence is complete. If the sentence cannot be analysed, the machine simply records the fact. This enables the linguists and mathematicians to correct the machine's programme so that it will be able to analyse any such sentences that may occur in the future.

The analysis of a Russian sentence requires the use of tree-like diagrams, which shows the phrases and clauses of a sentence as branches stemming from the subject verb and object, which form the trunk of the tree. Certain key words, such as conjunctions and prepositions, indicate the branchings of the sentence diagram. The machine can recognise such branchings, and distinguish between the main subject and verb of the sentence and the subjects and verbs which may occur in dependent clauses.

The final output of the machine is a sheet containing the original Russian sentence, the various possible equivalents of each Russian word in English, and the grammatical role of each word in the sentence. With this information, a person with little or no knowledge of Russian can prepare a finished translation.

The next step in this field of research will be to programme a computing machine to turn this material into a finished English translation, without the need for a human editor.

# Why Floor Warming?

Cold feet (in the literal sense of the words) always mean discomfort—everyone knows the misery of trying to get to sleep with freezing feet and the tardiness with which sleep comes. It is the same at any time of day; cold feet definitely mean discomfort.

A very great deal of work has been carried out on the optimum temperature for houses, offices and factories, with much importance attached to the kind of work expected of the occupants. Not so much seems to have been done on the temperature gradients that, of necessity, exist in any room or enclosed space with air circulation. Everyone knows that heat rises and the fact was recognised in the design of the heating systems for the Houses of Parliament, where the problem was to keep the feet warm and the heads cool.

It is particularly interesting, therefore, to find that this very point of cold feet received attention in some recent work carried out by the Building Research Division of the Commonwealth Scientific and Industrial Research Organisation at Melbourne. Seventeen subjects were used and their "comfort" checked against their foot temperature after they had been seated for 90 minutes in the test room. Comparison was also made with the air temperatures at 1 in and 30 in above the floor during the same period. The room was arranged to give little radiative effect and the air temperatures had a range from 60° F to 80° F. The gradients—upper minus lower—varied from − 5° F to + 10° F.

Agreement between "comfort" and temperature of the foot was found to be sufficient to use the latter in further correlation, and it was also found that for the majority of the subjects it was the temperature near the floor that determined the foot temperature. These results suggest that a better assessment of the comfort of a room can be gained by measuring the temperature near the floor than by trying to obtain an average value and allow for some hypothetical temperature gradient. They also suggest that whatever form of heating is used, it should warm the lower layers to give the best results from the comfort point of view.

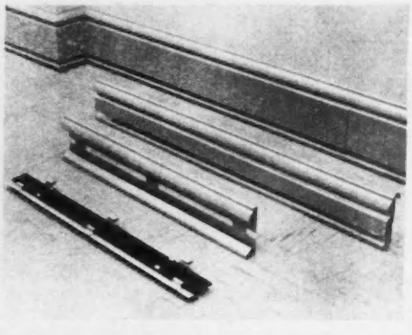
All this would seem to point directly to floor heating as the ideal arrangement and indeed it has proved quite acceptable. An immense amount of literature has been published on the subject and that it is no mere academic dream is proved by the fact that, at the end of 1959, well over 6,000 flats had been built using electric floor heating. It was estimated that 50 per cent of all new multistorey blocks of flats were being built for this method.

It is a basic requirement for all these floor heating systems that they be built into the house, and, of course, they can only be used in solid floors. These facts inevitably limit their use almost entirely to new buildings. Much research has been carried out by the Electrical Research Association on design considerations and economics, taking into account the use of plastics tiles, wood blocks and carpets as floorcoverings. In general, plastics tiles (providing they will not soften) offer little heat barrier. Wood blocks and carpets, particularly if the latter have felt underlays, necessitate a higher running temperature of the floor for the same surface temperature to the room.

There are two main types of electric heating, one in which the cables can be withdrawn at any time, and the other in which the cables are permanently imbedded in the concrete. There are at least five firms who make the parts for the former and nine who will carry out the latter type of installation. In one case, the cables are not imbedded in the screed but lie in channels in the wood blocks of a parquet floor, the blocks being grooved in manufacture so that when laid the grooves will line up to make the continuous channels on the underside.

An alternative form of floor heating makes use of pipes, preferably plastic, with hot-water circulation. Again, it is a system that is built with the house. It does not seem to have received a great deal of attention in this country, but a considerable amount of research has been carried out by the University of Illinois with grid panels built into floors, walls, and ceilings. Since the normal running temperature of heated floors is reckoned as 75° F to 85° F, the hot-water circulation system would seem to offer an application for a heat-pump installation, since the one requirement to improve the performance of this device is that the temperature rise demanded should not be too great.

For floors in upper rooms where imbedded cables are not possible, and also, therefore, for older houses, there is available an underfelt—the Thermalay—which has a heating element incorporated. A unit 9 ft square has a consumption of 875W, giving a very even heat over the whole area. A range of sizes is made, the largest being that of this years Electrical Engineers Exhibition, measuring 120 ft by 9 ft. The Thermalay is regarded by the Electricity Boards as sufficiently safe to be incorporated in floor warming systems as a permanent item. More recently still, a Wilton carpet has been produced by Bond Worth (in conjunction with Mersey Cables) in which a heating element is woven with the warp. The carpet is 12 ft by 9 ft with a consumption of 1 kW and operates at 25V; it is supplied complete with the necessary transformer. The makers state it to be proof against dogs, cats and children as well as accidentally-spilt liquids.



*Heating elements in the skirting board give an even distribution through the room. The Inferation unit is rated at 50 W per ft run.*

Low-level distributed heating is also given by the forms of skirting board heaters available. Types for both hot-water central heating systems and separate electrical supply are made. The Copperad Wallstrip for hot-water systems consists basically of a finned tube enclosed in a casing that takes the place of the normal skirting board of the room. Air louvres are arranged at the bottom and the top so that there is a circulation of air over the fins. Particular claims are that it is comparatively cheap to instal and that the even heating reduces fuel consumption.

A newcomer to the market is the Inferation skirting heater, illustrated here, which depends on an electrical element. Here also, the casing takes the place of the normal skirting board. Projection from the wall is about 1¼ in and the height is 7 in. The element is a carbon surfaced glass fibre unit which runs at black heat and is not liable to burn out. The normal rating is 50W per ft length so that a 20 ft length of skirting gives out 1 kW. Standard lengths are 2 ft and 3 ft.

The element is carried on the metal back plate that screws to the wall. The front section fits onto the back to form the two louvres at top and bottom. The top louvre is shaped to project the air across the room to give good heat distribution and to avoid wall blackening. Wooden skirting of the same profile is available to complete the surround of the room; it contains a channel to carry the connecting leads.

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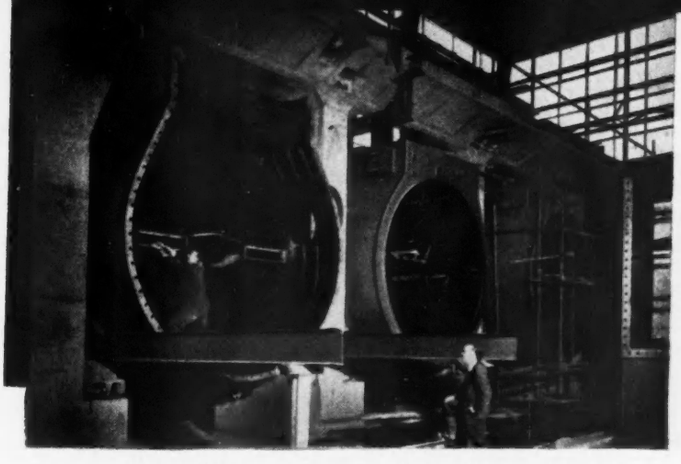

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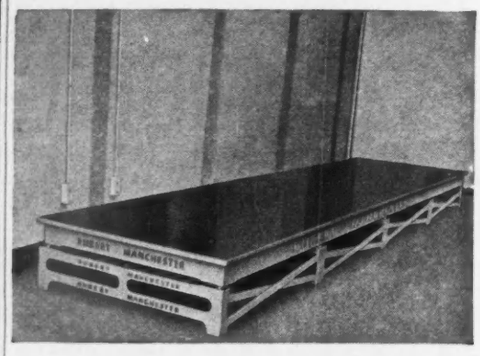


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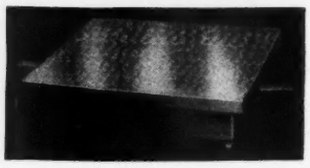

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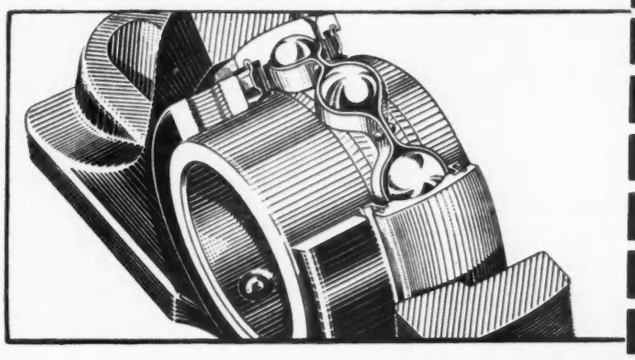

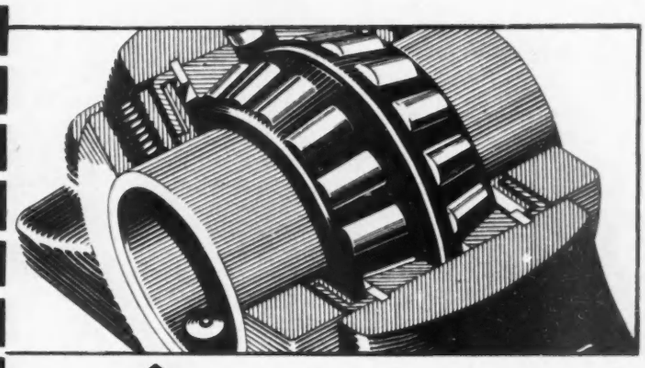

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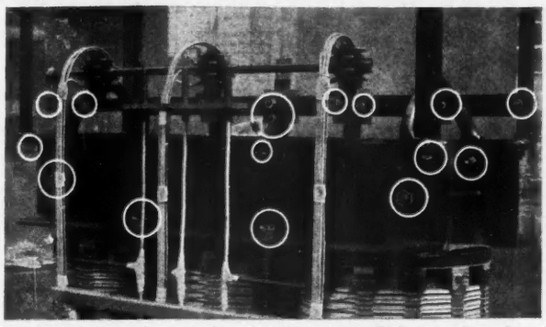

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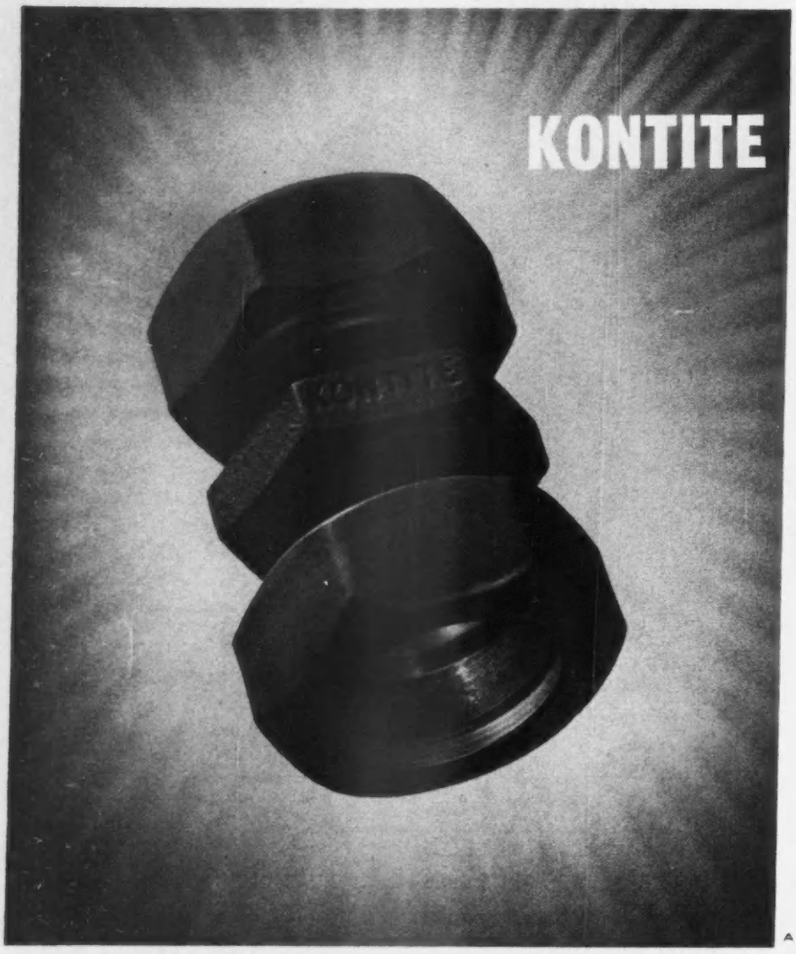


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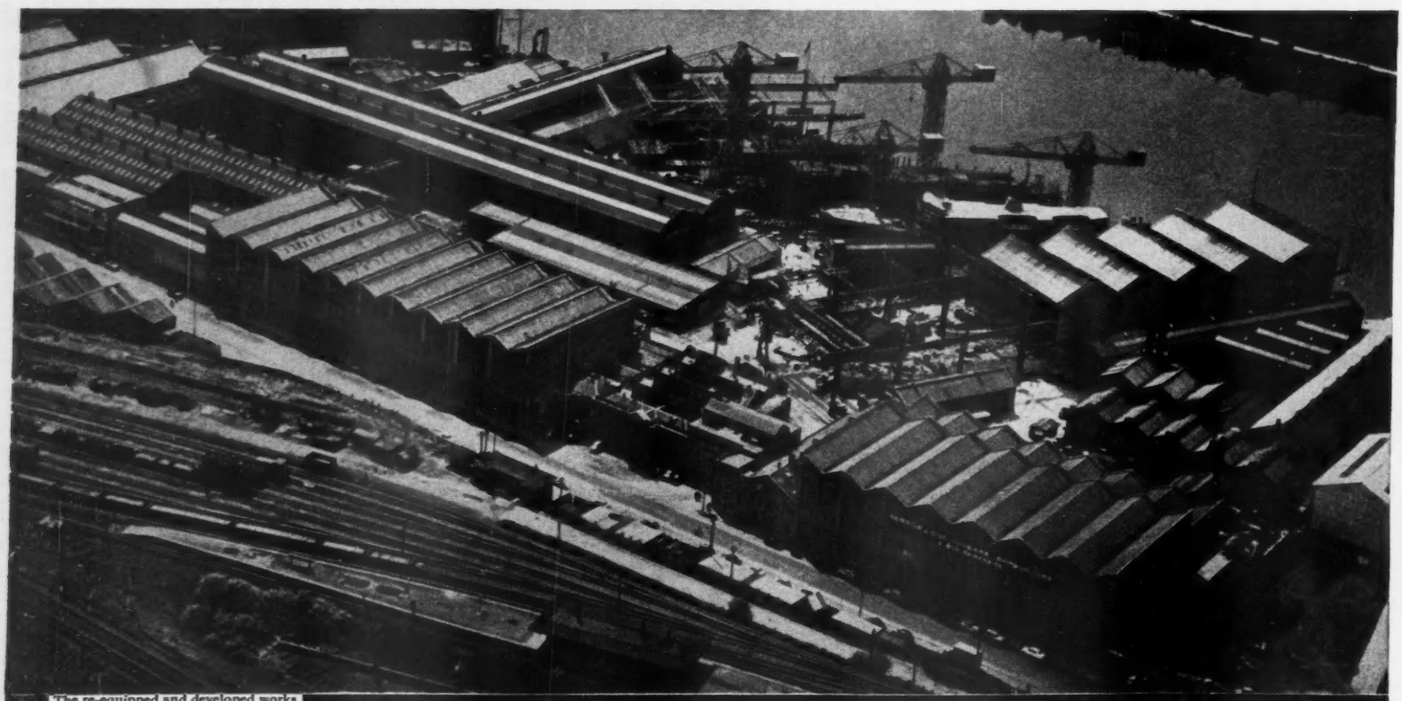

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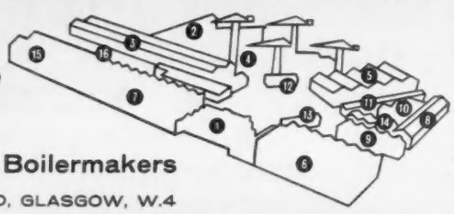

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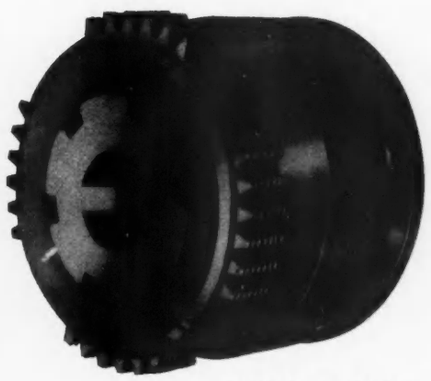

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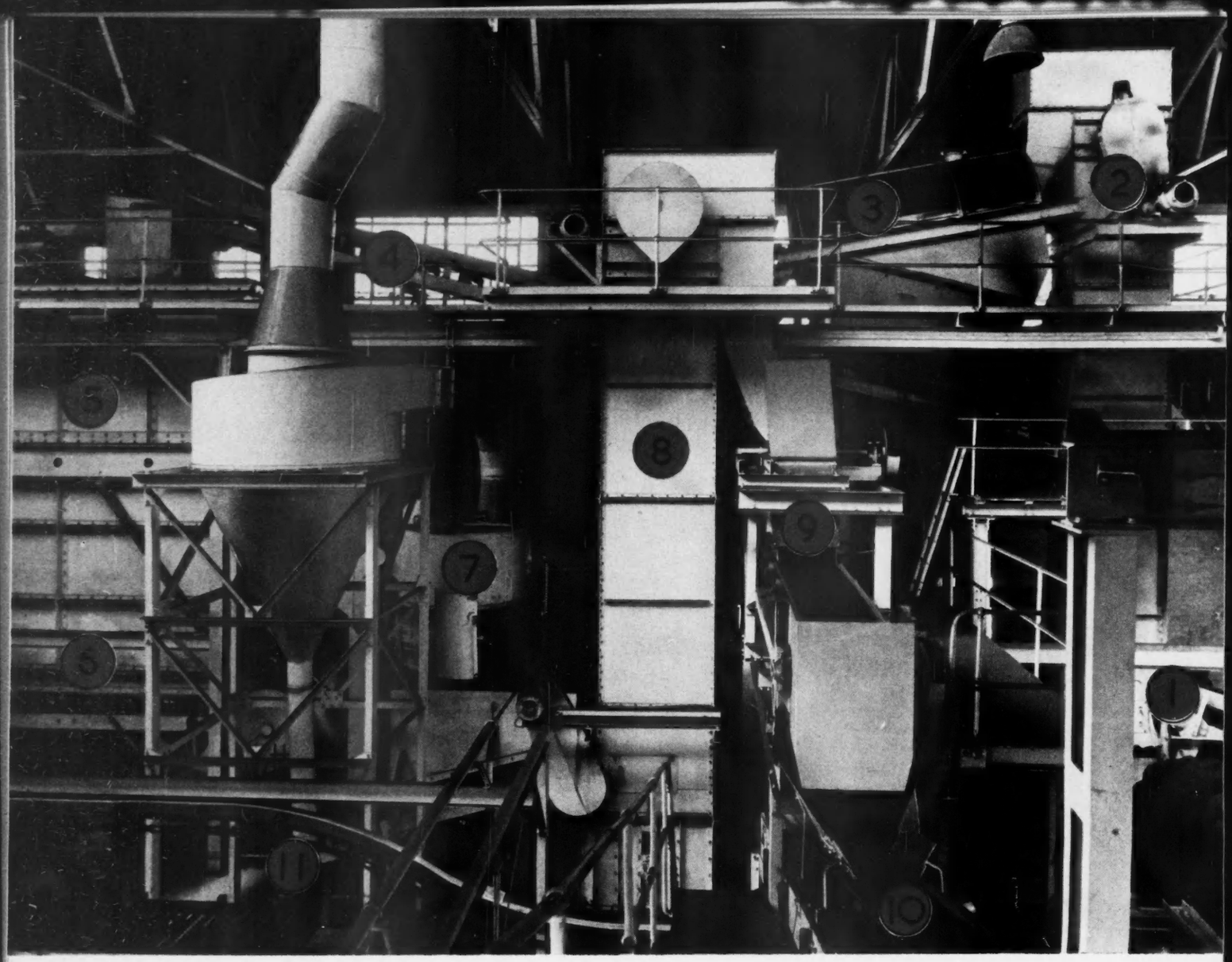


The illustration shows that part of a **MORRIS** foundry sand and mechanization plant which re-conditions knocked-out sand. At **1**, sand coming from the knock-out via an apron plate and belt conveyor passes beneath a magnetic separator (to remove tramp iron) and falls into the boot of a belt-bucket elevator, **2**, discharging into screen **3** onto belt conveyor **4** which in turn discharges into sixty-ton storage hopper **5**. The flat belt conveyor, **6**, under the hopper, pours sand into the skip which feeds the mulling machine (known as the Speedmullor). This machine **7**, providing a rapid mulling cycle with close batch control, discharges the sand into belt-bucket elevator **8**. From thence, the sand proceeds via belt conveyors **9** and **10** to the moulders. The overhead chain conveyor **11** serves the core shop with sand and also takes the cores to the stoves and to the moulders.

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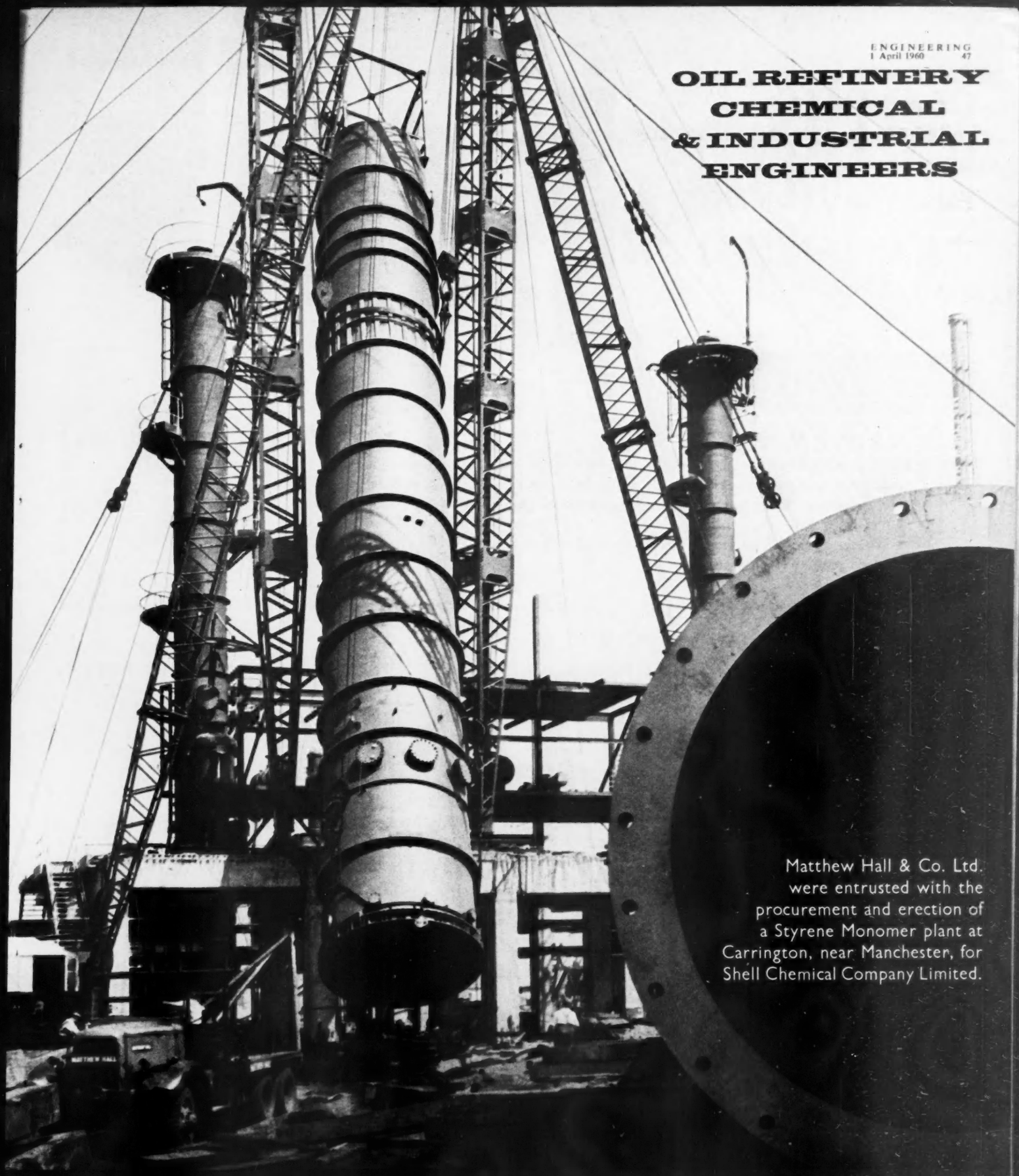

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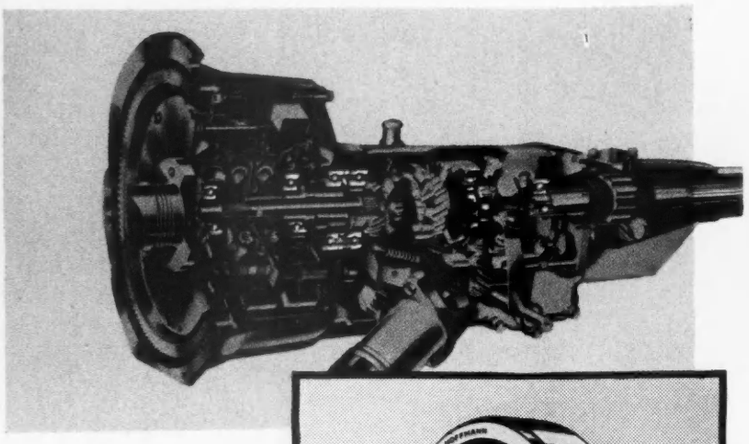

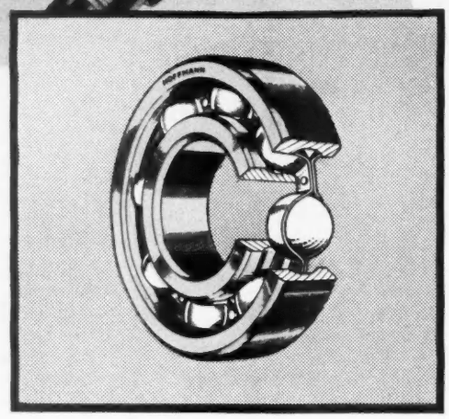

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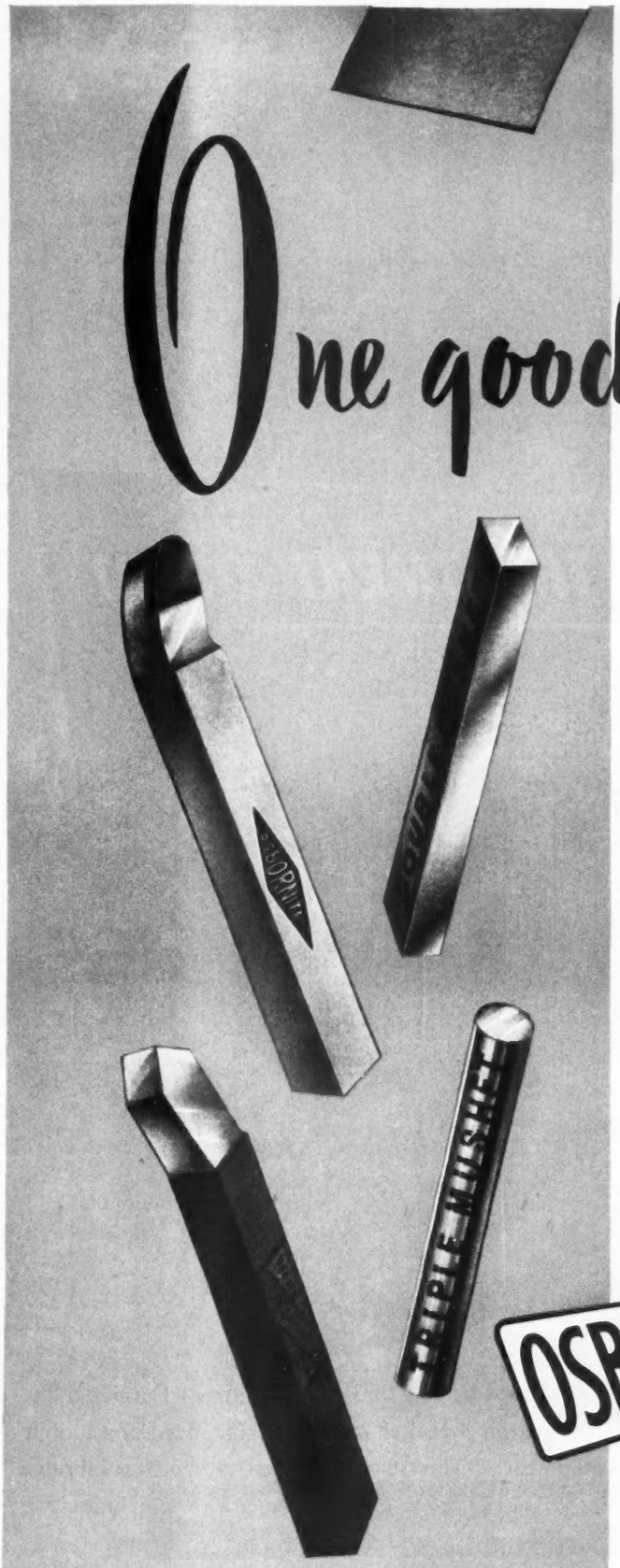

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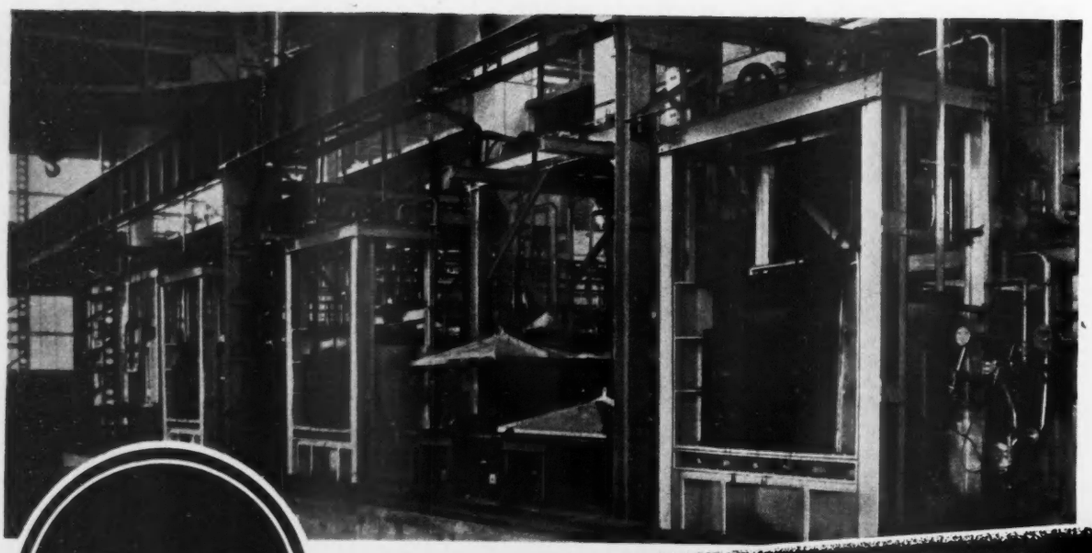

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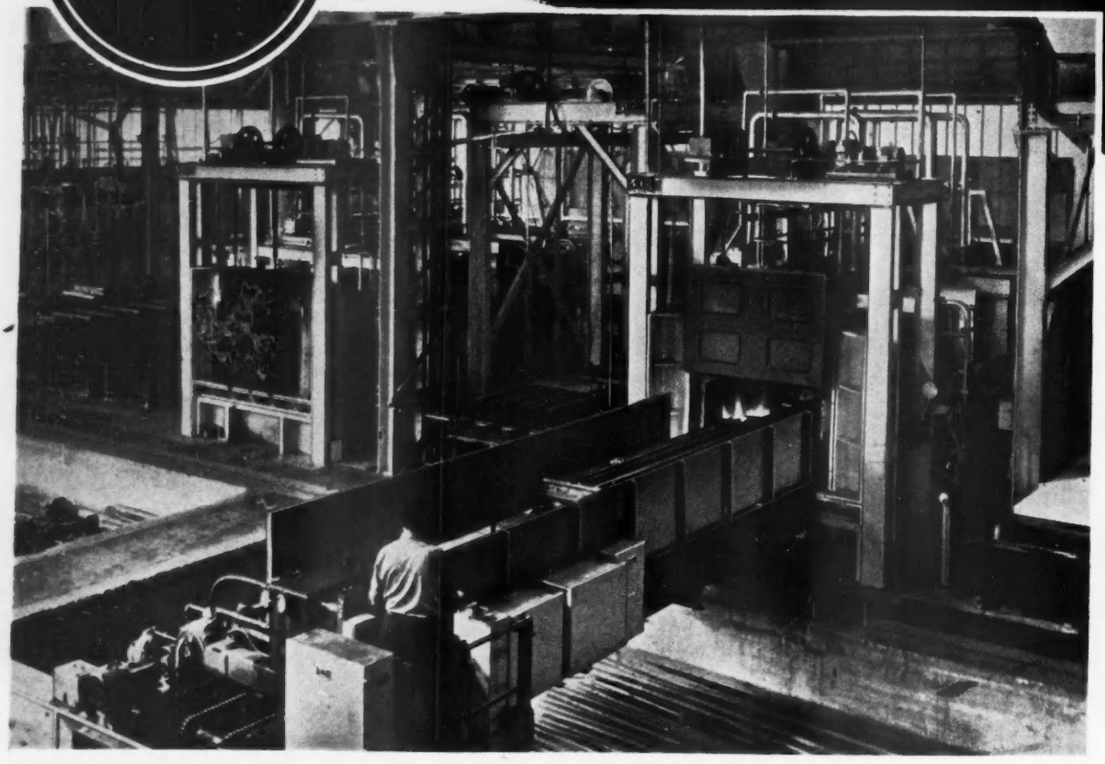

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The illustrations show a battery of 3 Heat Treatment Furnaces, one with recirculation, 5 ton 3 peel charging machine, fixed and mobile quenching equipment. This plant, installed at the Stocksbridge Works of Samuel Fox & Company Limited, also includes two Bogie type Furnaces with special transfer charging machine.

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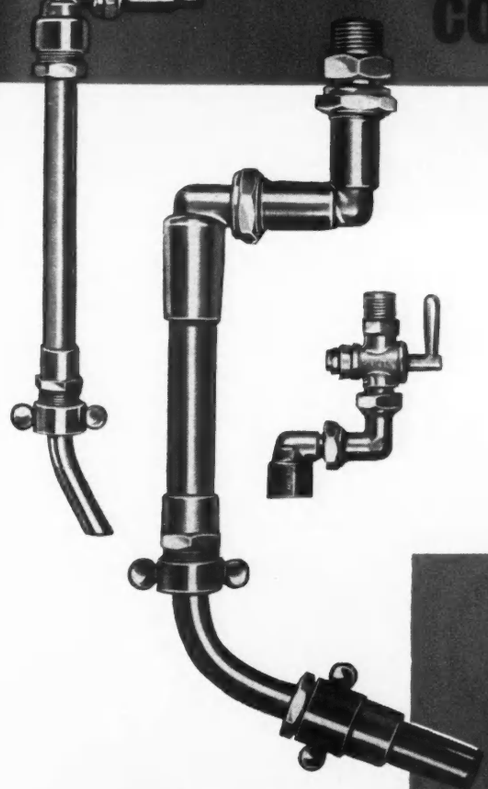

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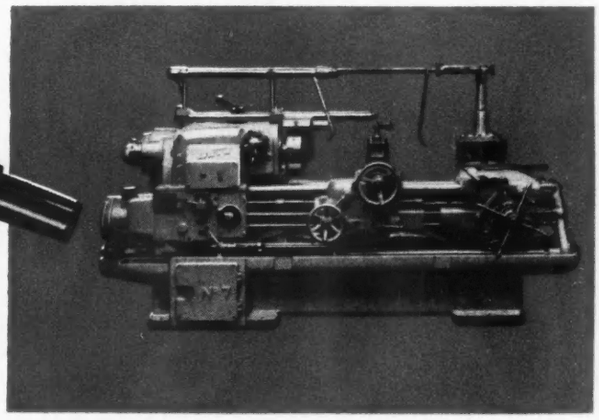

Photograph by courtesy of H. W. Ward & Co. Ltd., shows Enots Coolant fittings on a No. 7 'Prelector' Combination Turret Lathe.

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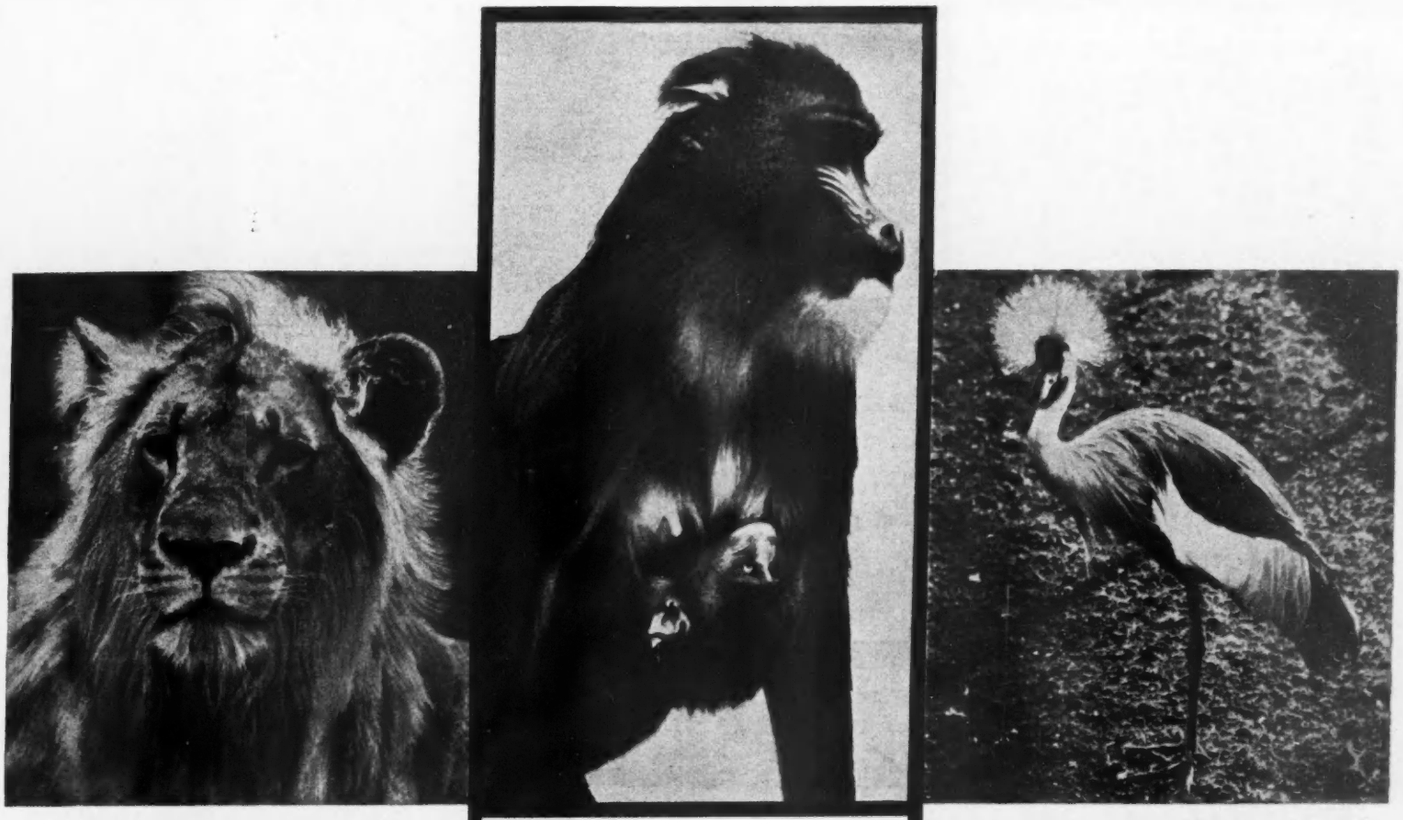

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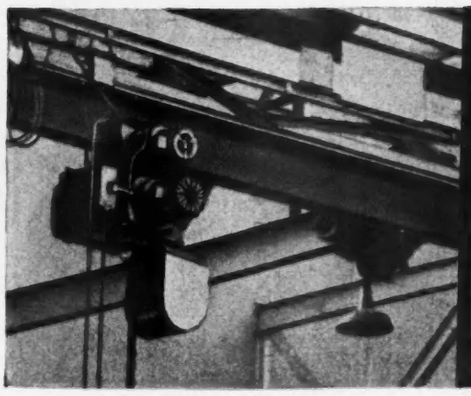

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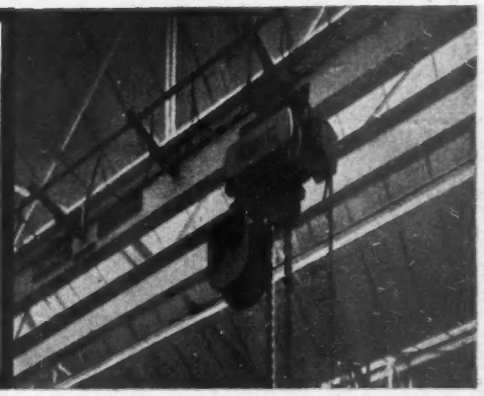

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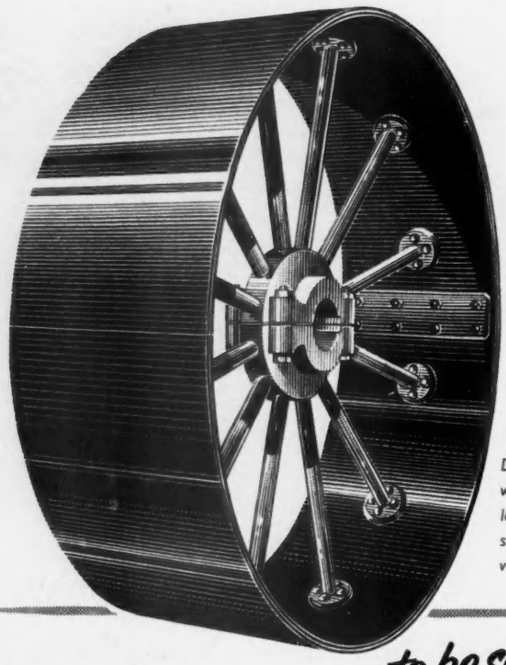

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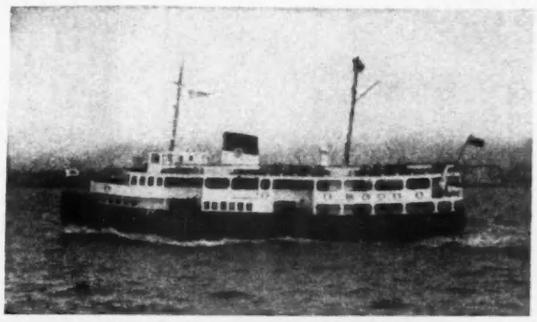

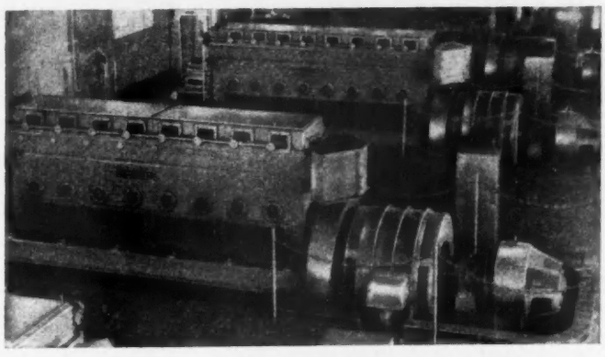

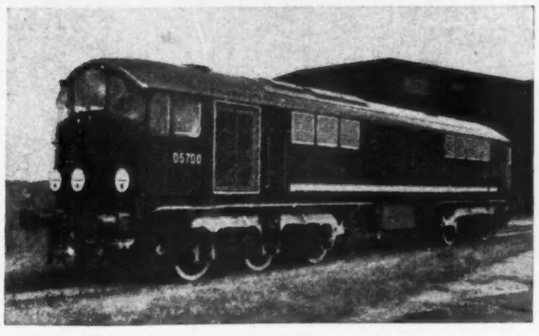

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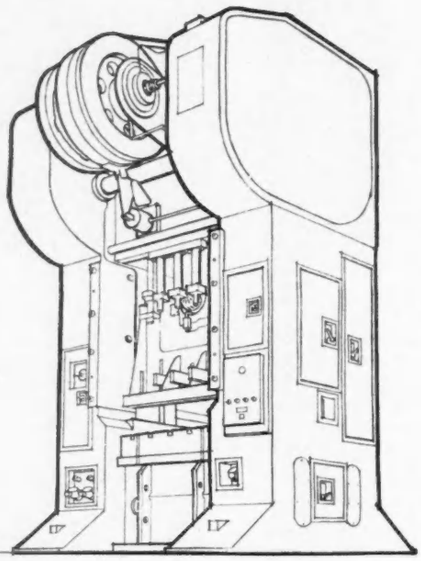

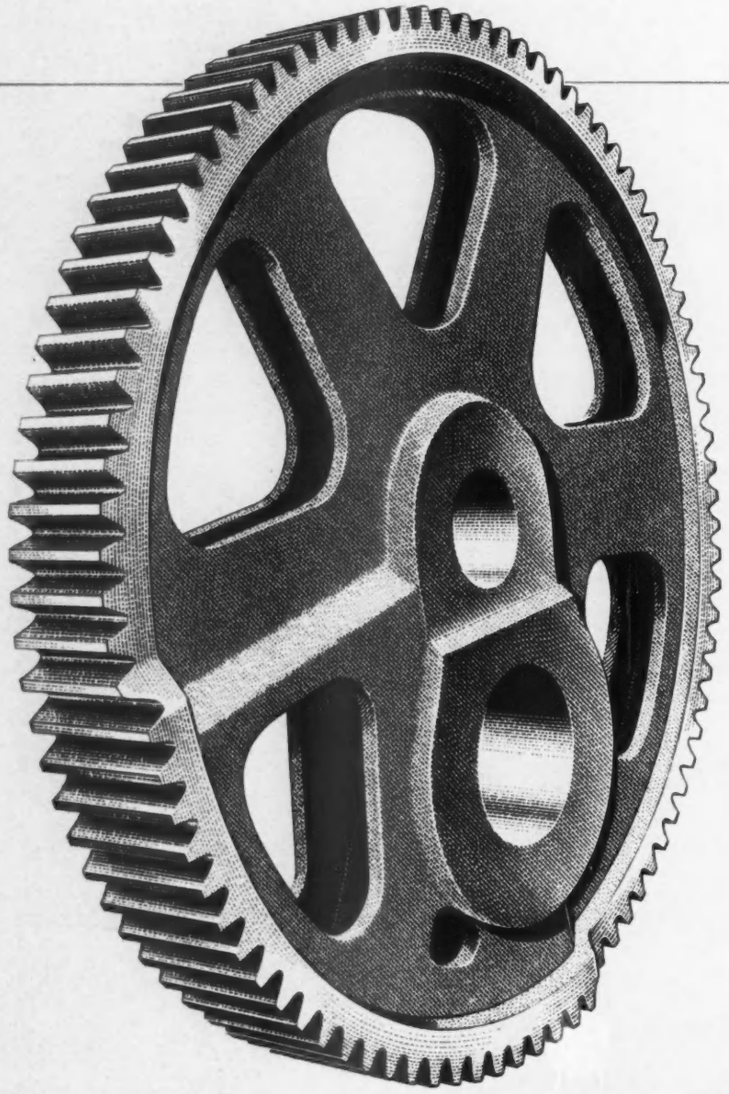

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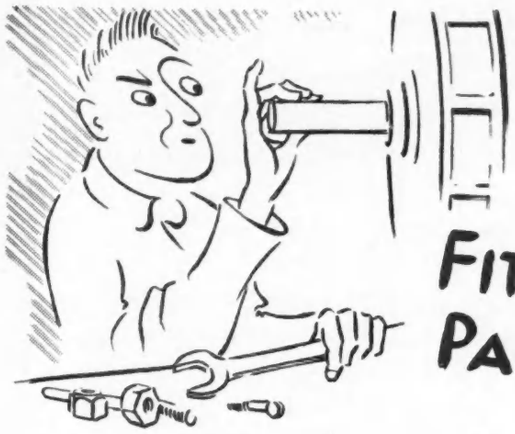

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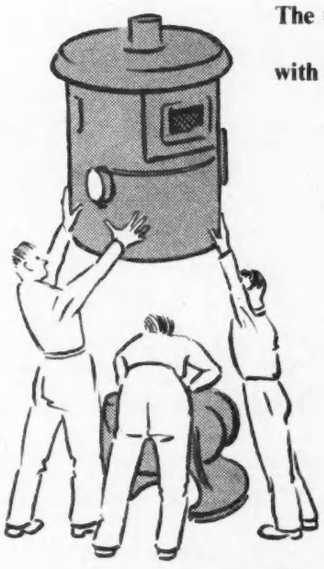

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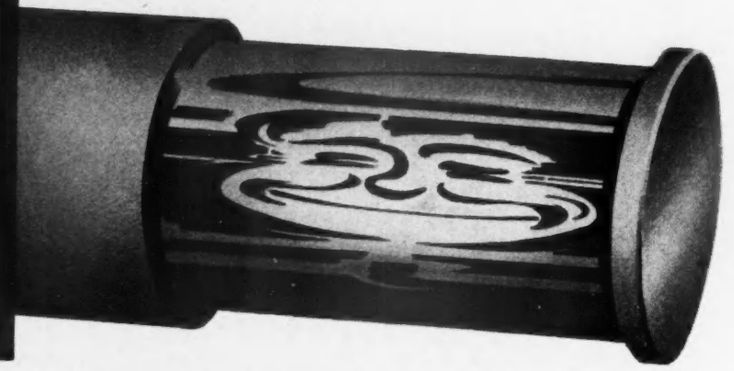

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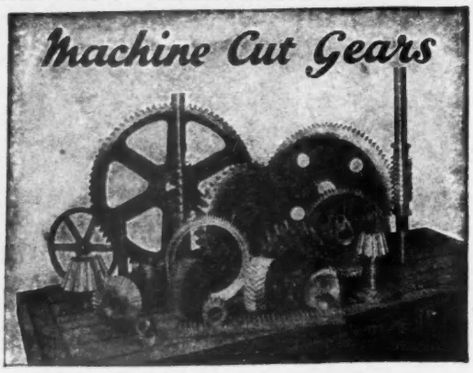

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# —WET or DRY?

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DU Bearings have been described in America as "a sensational break-through in bearing technology". The reason for this is that although dry bearing materials had been in use before—process industries and extreme-temperature-duty applications, for example—until GLACIER developed DU, no dry bearing material had been discovered which combined such low friction with such high resistance to wear and great mechanical strength. DU Bearings for the first time widen the scope of dry bearings to include almost every application. They were originally developed —and are made exclusively—by GLACIER.

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DU, the material from which GLACIER DU Bearings are made, consists of a tin-plated steel backing on which a thin layer of porous bronze is laid. This is impregnated with a mixture of lead and a fluorocarbon known as FLUON*. DU combines all the advantages of these materials, including resistance to wear, low friction and anti-adhesiveness, high thermal conductivity, low thermal expansion, high mechanical strength, wide service temperature range—from −200° to +327°C.—resistance to abrasive atmospheres, elimination of contamination, and the ability to run submerged even in corrosive liquids—often with improved performance. Its lasting powers are excellent; it can carry heavy loads at high speeds; it requires no attention and of course no oil whatsoever.

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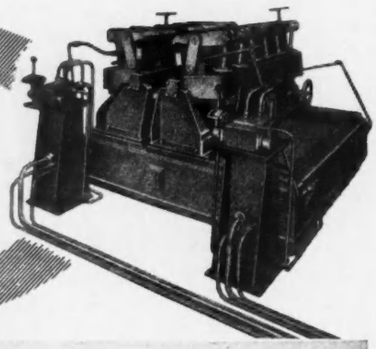

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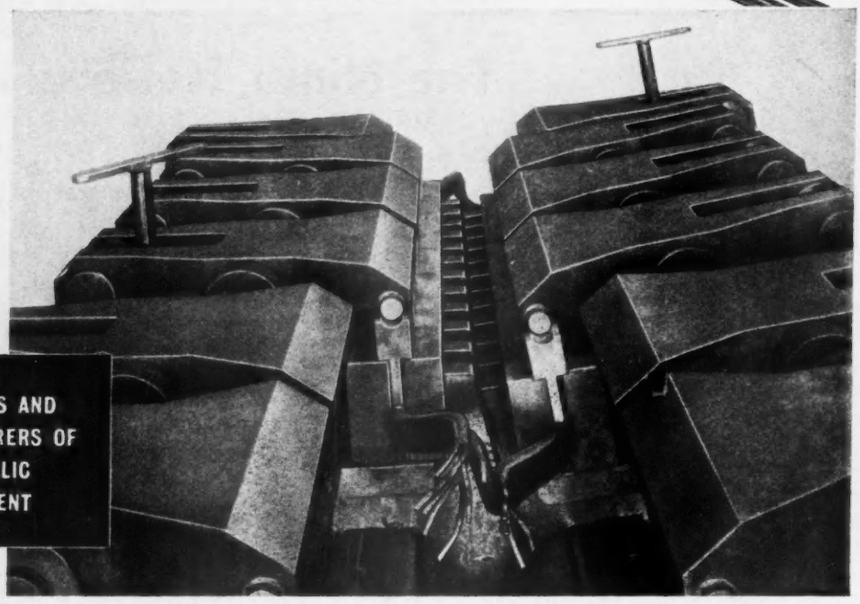

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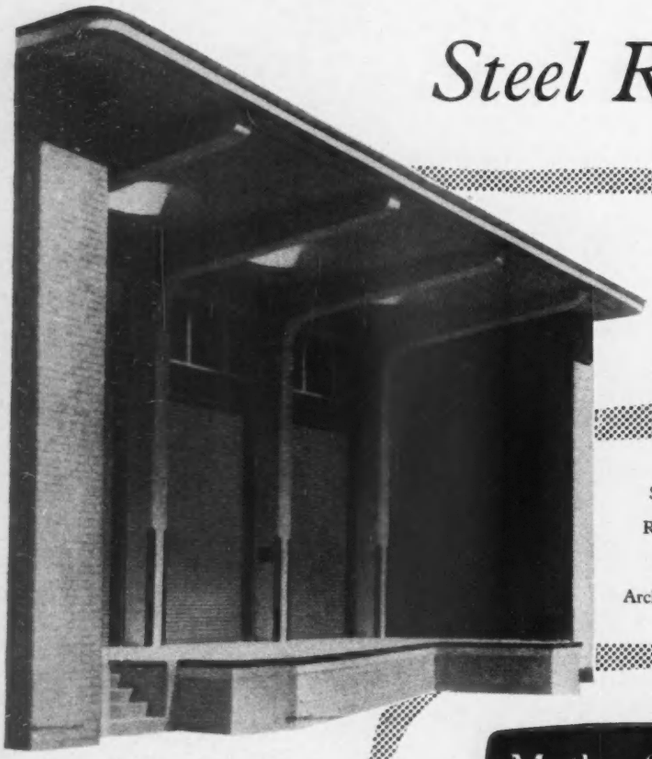

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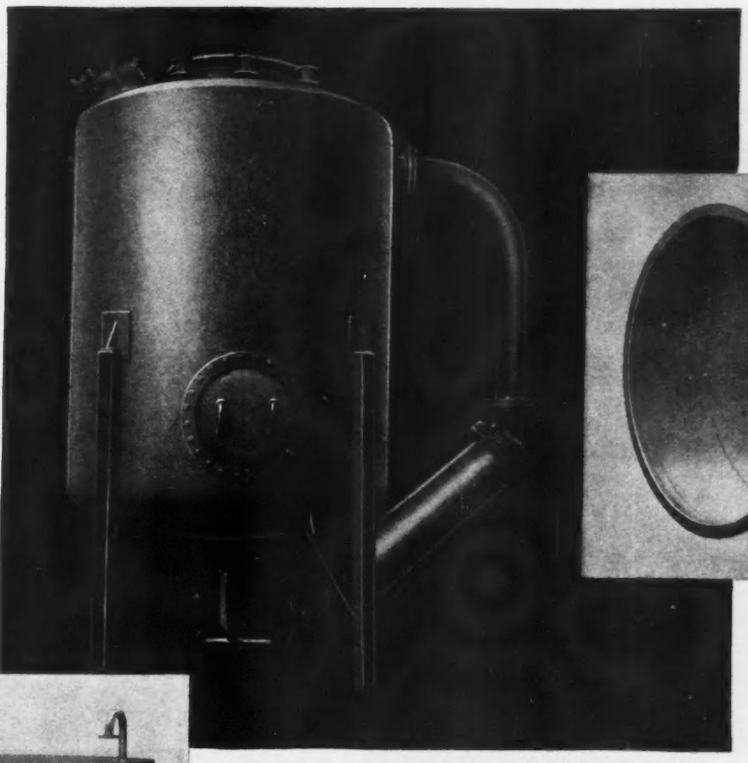

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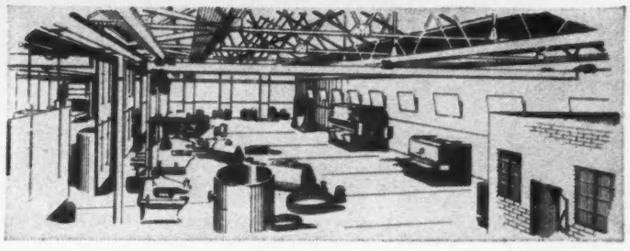

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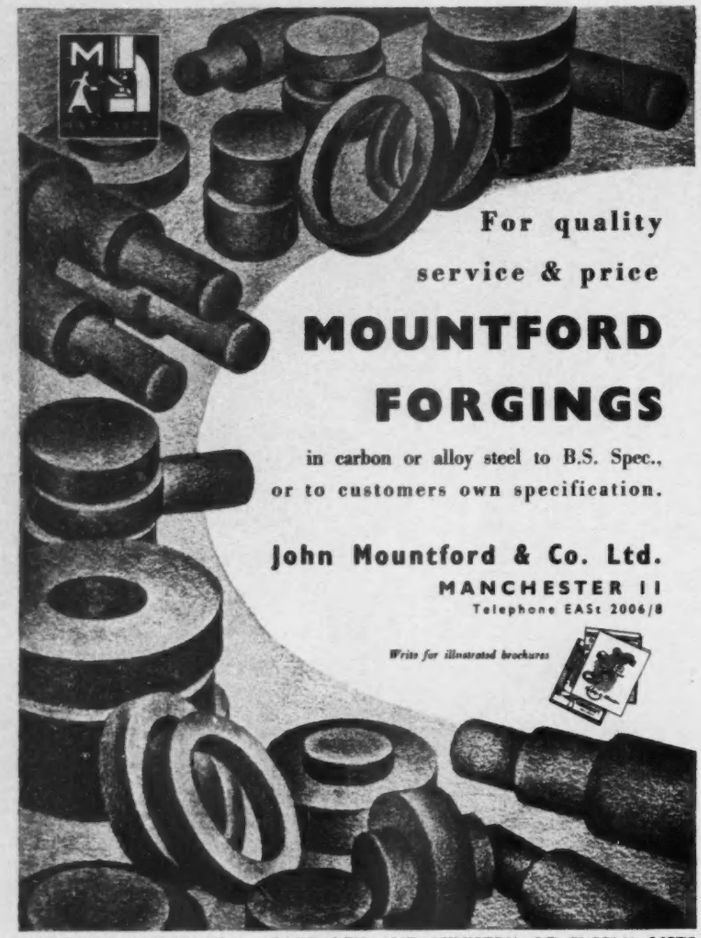

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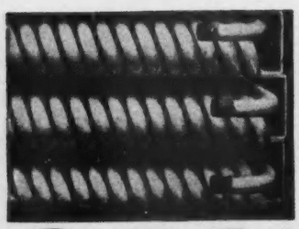

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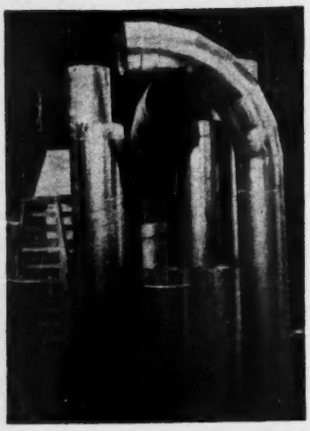

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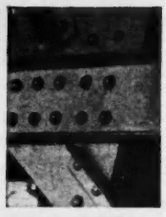

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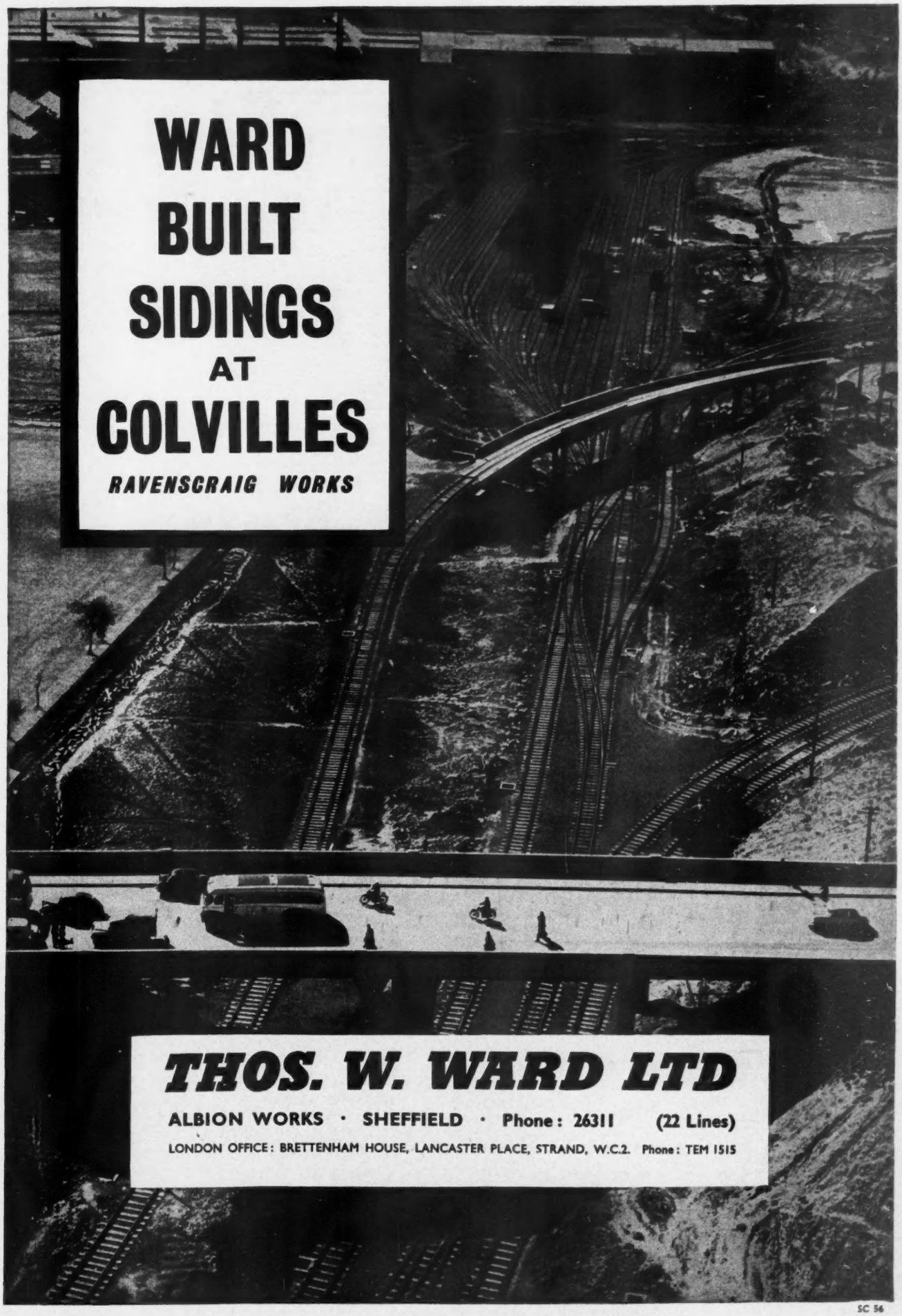
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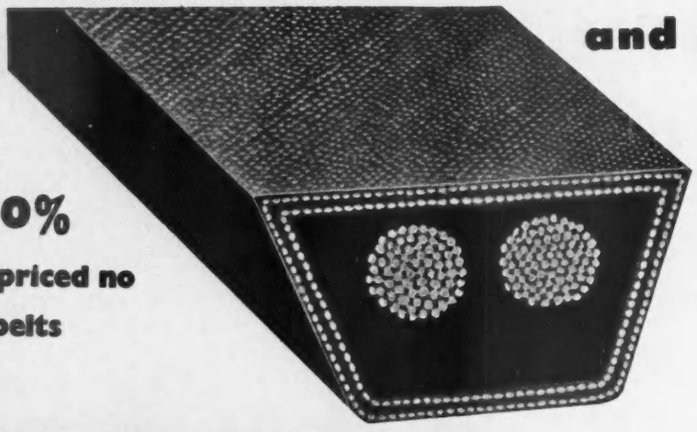
between this  and any other V-belt

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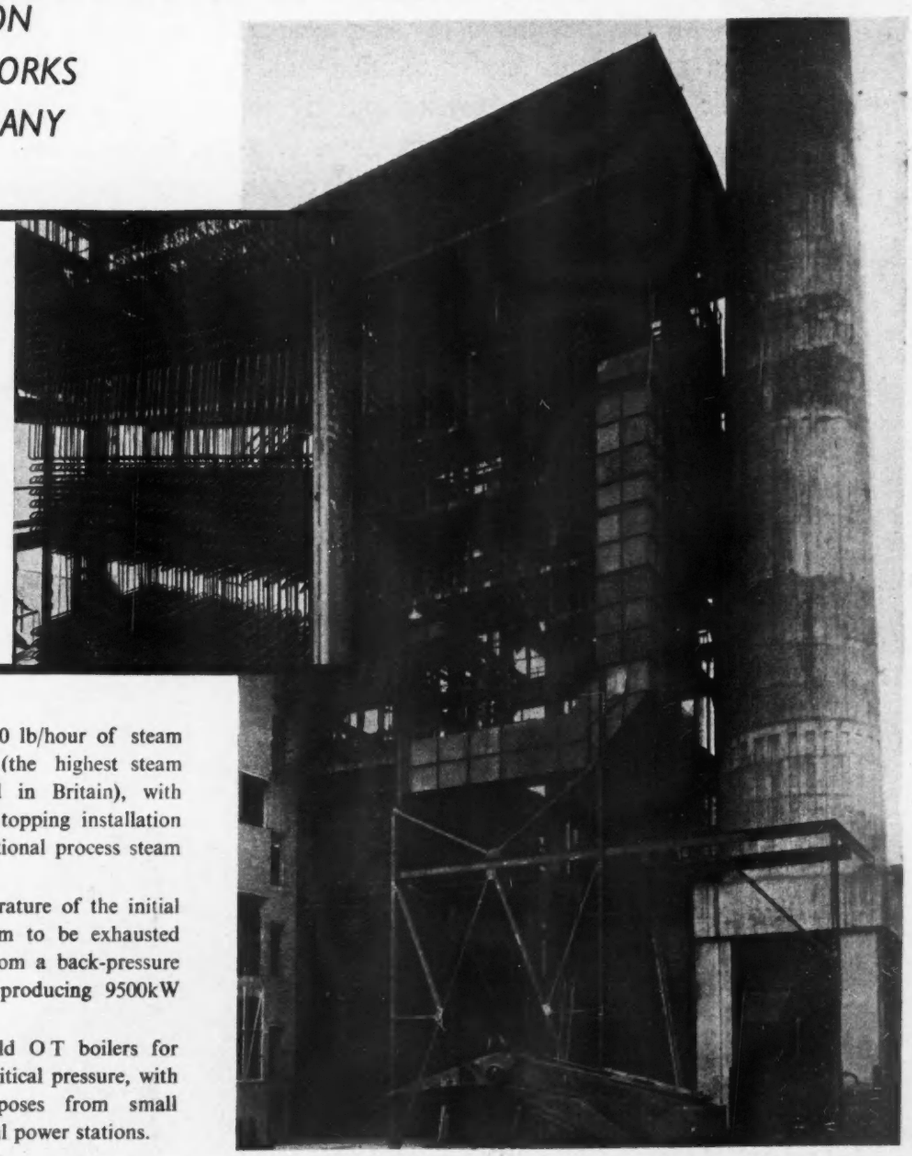

**Main illustration.** *A general view of the boiler under construction. This is an outside job, but the operating front is housed in the turbine building.*

**Inset illustration.** *This close-up of the top three banks of the evaporator, taken before the chamber walls were fitted, shows the type of evaporator surface.*

This O T boiler, generating 240,000 lb/hour of steam at 3,300 p.s.i. and 1,060 deg F (the highest steam conditions yet commercially used in Britain), with reheat to 840 deg F, forms part of a topping installation to supply the steelworks with additional process steam and electric power.

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Simon-Carves can design and build O T boilers for operation above, at or below the critical pressure, with steaming capacities for all purposes from small industrial plants to the largest central power stations.

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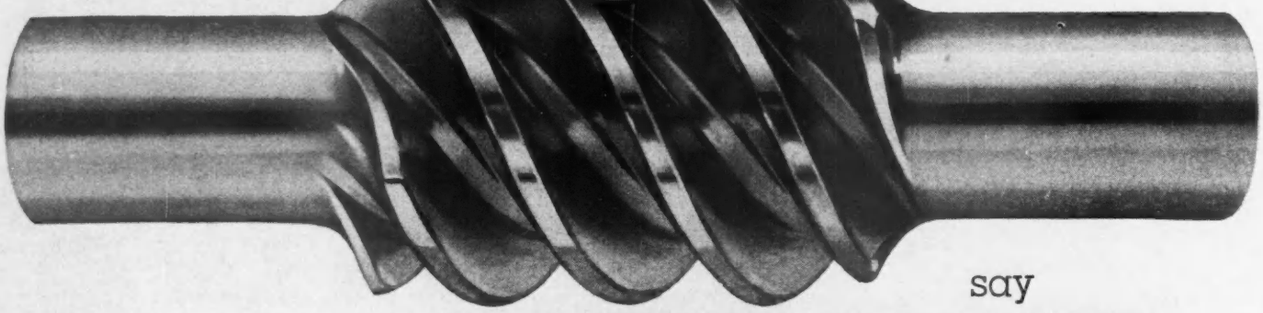

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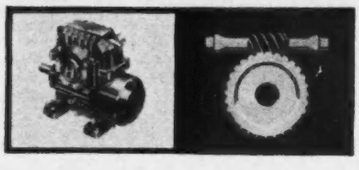

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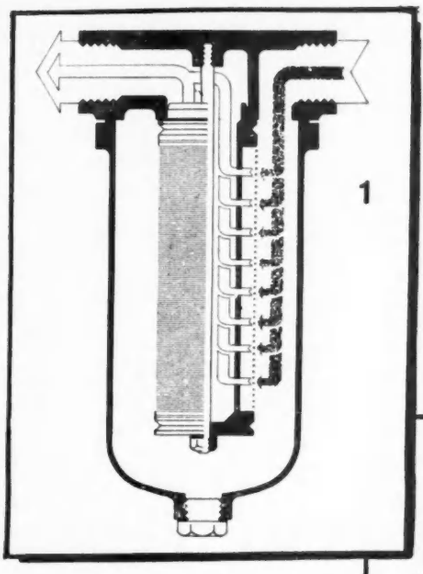
# INSIDE INFORMATION

# ON MODERN FILTRATION TECHNIQUES




## AUTO-KLEAN LOLOS (1)

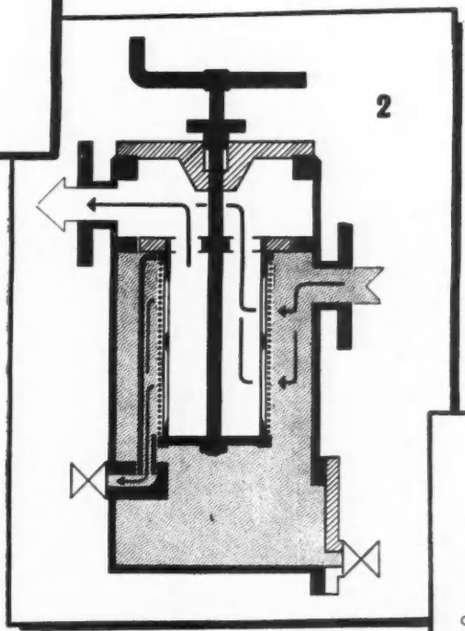
This is a range of filters incorporating wire-wound elements designed for ultra fine filtration of low to medium viscosity fluids under pressure.

**Principle:** A ribbed cylindrical former is screw cut, and a continuous monel or stainless steel wire is tightly wound into the grooves. By altering the pitch and/or the diameter of the wire defined alterations of mesh can be accomplished. LOLOS L.F. filters have a fabric sleeve fitted over a fine mesh wire-wound element.

**Advantages:** AUTO-KLEAN LOLOS filters ensure ultra fine filtration *with negligible pressure loss.* Their robust construction remains non-collapsible under extreme pressures, requiring practically no maintenance. Also important is its small lightweight construction.

**Data:** Working pressures can be arranged up to 2,000 lb/sq.in. Also included in the range are duplex and multi-element designs.

**Typical Applications:** Hydraulics; fuel and lubrication systems in air, sea and land transport, cooling circuits; distilleries; irrigation lines; washing and bottling plants, etc.




## AUTO-KLEAN FLUSHFLO (2)

This is a range of self-cleaning filters specifically designed for continuous operation in the cooling and lubricating systems of heavy machinery.

**Principle:** Sludge collected by a wire-wound element is dislodged by reverse flow, while the filter element is electrically or manually turned. In contact with the wire element is a spring-loaded slotted tube which acts simultaneously as 'scraper' and discharge passage.

**Advantages:** The FLUSHFLO is completely self-cleaning while in service without interruption of liquid flow. It ensures fine, positive full-flow filtration with very low pressure losses. And, because the sludge is removed automatically without dismantling, its use leads to reduced maintenance costs. FLUSHFLO filters are also noted for their large capacities relative to size.

**Data:** Capacities and mesh dimensions fully tabulated in Auto-Klean literature. Quotations on request for processes and capacities not already covered.

**Typical Applications:** Large scale oil and water cooling circuits; hydraulics; washing plants; water treatment plants; machine lubrication, etc.

## AUTO-KLEAN MICOM (3)

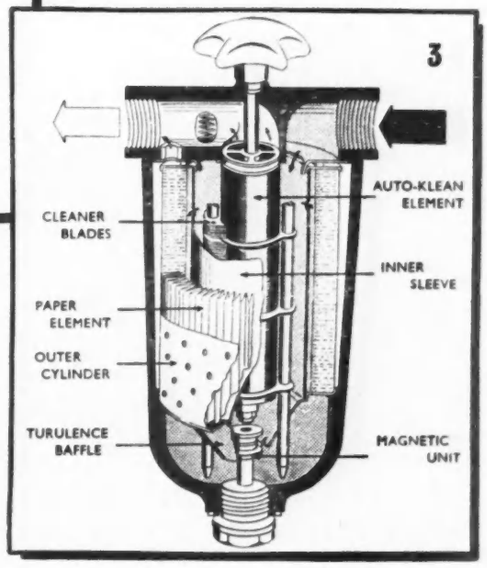
The MICOM combines the advantages of paper as a clarifier with the efficient characteristics of an Auto-Klean, self-cleaning, plate-type element in a full flow filter.

**Principle:** The greater part of the fluid passes through the plate-type element, while the remainder is filtered by the paper. *The whole of the filtered liquid passes to the outlet side of filter,* thereby giving the maximum protection to the system. A magnetic unit is also incorporated as additional protection against micronic ferrous particles.

**Advantages:** Positive filtration is guaranteed despite build-up on paper element; paper cannot collapse through choking and therefore its lifetime is increased; constant pressure is maintained as build-up on paper increases . . . while the plate-type filter can be automatically cleaned by turn of the handle—without dismantling. Also important is the low pressure loss and small, lightweight construction of the MICOM.

**Data:** Working pressures up to 50 lb./sq.in. Can be supplied with ratchet gear for link drive from moving mechanism.

**Typical Applications:** Ideal for diesel engine lubrication systems of the medium horse-power range and other similar recirculatory applications.

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This John Thompson development gives a new freedom to designers; a relatively thin inner cylindrical shell is reinforced by multilayers of thin plate surrounding the cylindrical section of the vessel. These layers carry both the hoop stresses and the longitudinal stresses. The ends are hemispherical or dished as required.

In this way the difficulties inherent in designing and fabricating cylindrical shells in very thick plate are overcome and it is not necessary to have recourse to expensive alternative spherical designs.

The techniques of this method of fabricating have been fully worked out by John Thompson and open up entirely new possibilities for the economical construction of very large high-pressure vessels for chemical and nuclear projects. The method also offers freedom in design for vessels not of the largest size but needing to operate at very high pressures.

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